MARCH 1954

APPLIED HYDRAULICS

THE MAGAZINE OF **FLUID POWER** TRANSMISSION

INCLUDING AIR CONTROLS AND AIR CIRCUIT DESIGN; ELECTRICAL CONTROLS

DESIGN FOR SMOOTH ACTION 59

AN ELECTRO-HYDRAULIC SERVO PUMP 63

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FRANCHISE CIRCULATION

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When HOOK-UPS are being planned or altered

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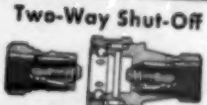

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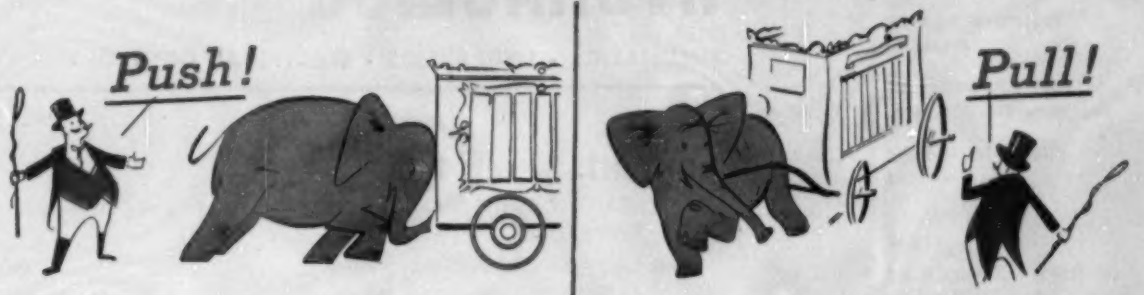

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MARCH, 1954
Vol. 7, No. 3

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PNEUMATICS - HYDRAULICS - ELECTRICAL CONTROLS

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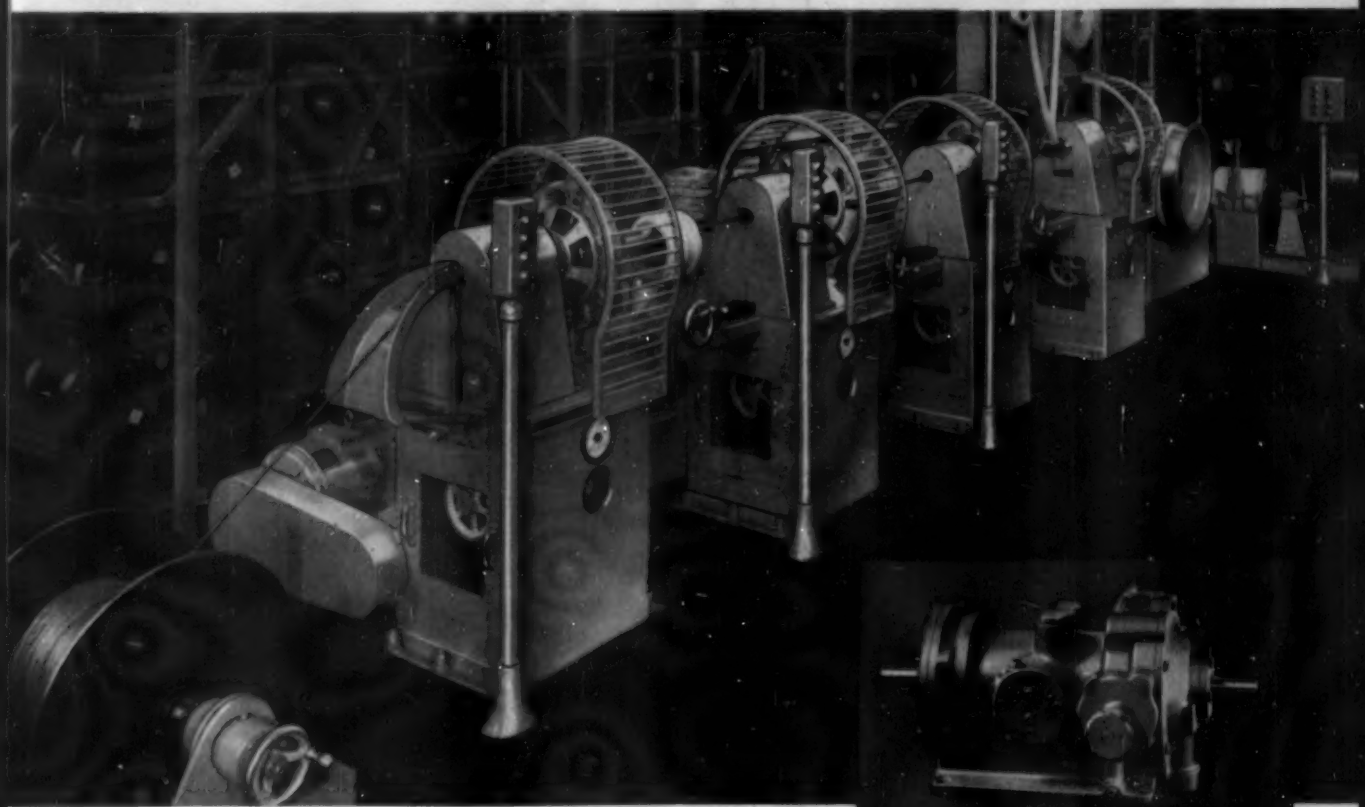
MACHINE DESIGN AT WESTERN ELECTRIC



Its use of Oilgear Fluid Power

Western Electric Company, manufacturing unit of the Bell Telephone System, originates, designs and builds many of the special machines it uses in its own manufacturing processes. It also maintains unceasing pressure to improve upon machines already in operation, for optimum performance, for better product, for lower costs, for freedom from trouble.

Its use of Oilgear Fluid Power Drives and Transmissions has been increasing because, in the words of their engineers, Oilgear enables them among other things to synchronize many machine components easily and economically. A good example of all these points is the "short haul" video cable wrapping machine pictured above.

This machine was designed and built by the company's own men some years ago. For optimum performance, the speed of the heads should be easily and independently variable and the direction of rotation instantly changeable because the lay and pitch of the wrappings must be varied according to the requirements of the run. Moreover, the inside contour of the tube formed by the wrapping should be smooth and uniform so as to avoid setting up echo waves that interfere with transmission and vitiate signal strength.

Because of these requirements, a new drive was installed something over 4 years ago. A line shaft drives five Oilgear Fluid Power Transmissions, one at each machine head and the capstan.

The results were these: uniformity and control of tension are so good, the machine runs at 4 times its former machine speed; it is easy to vary speed and direction of rotation of each individual head; eccentric heads gave way to concentric heads, and supply spools are now loaded to full capacity instead of ¼th to ⅛th as before; the machine is stopped less frequently for loading. Maintenance on the former drive was involved and frequent—on the Oilgear equipment it has been simple and negligible.

There is some reason to suspect that Oilgear Fluid Power with its wide range of advantages may solve some of *your* machine design problems and make the results very pleasing and profitable. Why don't you really find out? THE OILGEAR COMPANY, 1564 West Pierce Street, Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

PIONEERS ... IN FLUID POWER PLANTS FOR FINER PRODUCTS

APPLIED HYDRAULICS

Fluid Power Lines

Saving Air

We had an interesting visit last summer with Tom Sykes who heads the research and engineering department of the Toronto Daily Star. Some years ago, the management of this progressive newspaper set up an engineering department to develop methods and equipment for producing newspapers. One of the developments is the paper baler described in this issue.

One of the features of this machine is a patented air saver valve. With this valve, air used on the forward stroke is also used to return the cylinder. The article tells how it operates.

Because we don't think about machines when we read "Pogo", we hadn't expected to find a bustling engineering group in a busy newspaper operation. It is of course a logical department to have in a newspaper plant. It takes many machines to turn out that daily paper product at high speed and in large quantities.

Reprints of the 32 page circuit section which appeared in January are available. Single copies 50c; 40c in lots over 50; 35c in lots over 100.

Round Table on Nonflams

One of the most interesting sessions of the 1953 National Conference on Industrial Hydraulics was the discussion about nonflammable fluids. We felt that the question period was most valuable because the questions from the audience undoubtedly are a measure of the questions to which engineers throughout the country would like answers.

In this issue, we've printed the question and answer period. Ably chairmanned by Texas Company's Jack Van Gundy, the panel included H. Stuart Litzinger, Monsanto Chemical Company; W. H. Millett, Carbide and Carbon Chemicals Company, Division of Union Carbide and Carbon Corporation; Don P. Morrell, Ford Motor Company; James Robinson, Vickers, Inc.; Carl E. Schmitz, Crane Packing Company.

Servo Pump

One of the best examples of servo design is applied to the operation of a variable volume pump. Pump delivery can be made to respond to a signal. How this is accomplished is described in Norton Williams' article.

Smooth Operation

This month's guest editor, Joe Clancy, tells about a low pressure hydraulic system on a special furnace application. All movements had to be as gentle as possible; any vibration or shock could spoil the work. Flow control valves control speed in both directions of cylinder travel. A low pressure system minimizes shock as the electrically actuated valves shift.

Joe Clancy, who has been with the Gibson Engineering Company since 1945, has worked with many customers in the New England area on pneumatic and hydraulic applications. In his article you'll find data on the electrical control circuit for timing the hydraulically powered motions.

Pump Control

Ben Blake and Allan Steel of Scovill Manufacturing Co. in Waterbury, Connecticut have written an article which shows their method of controlling pump operation on large extrusion presses having a water hydraulic pump-accumulator system. To obtain an efficient control which does not require continuous maintenance, they designed a new level sensing device and valve actuating mechanism.

Next Month—TOOLING

During the week of April 26th, we will join thousands of engineering and manufacturing personnel at the American Society of Tool Engineers Industrial Exposition. APPLIED HYDRAULICS will have booth 2160. We hope to see you there.

Articles for our April issue are being selected to show "How to Use Fluid Power for Better Tooling". There will be many short articles giving you ideas on how to use air and oil to clamp, index, and feed machine members. You'll read about successful designs for safety, high production, and economy. There will also be design ideas for material handling and test equipment and air powered tools.

"THIS CASE IS SEALED!"

with 12

Precision Dyna-seals

This immersion proof case, designed by the ConRay Corporation, of Dayton, Ohio, provides a perfect example of efficient sealing with *Precision* Dyna-seals. Engineered for moulding from Fiberglas impregnated thermo-setting resin, the case is designed to protect electronic equipment during storage or shipping. It is immersion proof, vapor proof, resistant to chemical and mechanical damage. *Dyna-seals* allow long term storage without breakdown of sealing action and permit equipment to be placed in service without delay.

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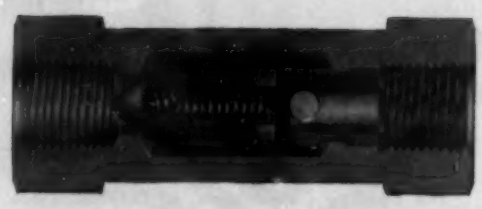

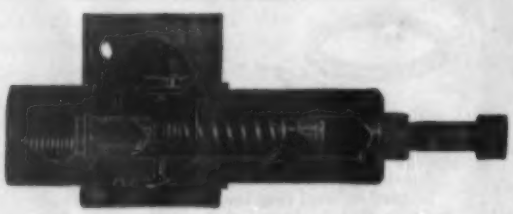

CHECK VALVES

CHECK VALVES One piece construction—no welds to crack. Nylon Poppet assures leak-proof service. Light weight aluminum body. Low pressure drop. Available in 3/8", 1/2", 3/4" and 1" NPT line sizes.

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ADJUSTABLE FLOW REGULATORS for cylinder speed control over a 50% range for pressures to 3000 psi. Meets requirements for cylinder speed adjustment yet maintains constant speed regardless of work resistance or pressure fluctuations.

For Machine Tools—Farm Equipment—Packaging Machinery—Steel Mills—Refineries etc. Four sizes: 1/4", 3/8", 1/2" and 3/4 inch. Overall length 4 1/2 to 7 1/2 inches.

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UNLOADING VALVES for system pressures to 3000 psi. Flow rates to 30 G.P.M. Fast acting, easily adjustable, maintain desired pressure settings without continuous readjustment. Hardened poppets eliminate leakage. Large passages assure maximum flow with minimum pressure loss.

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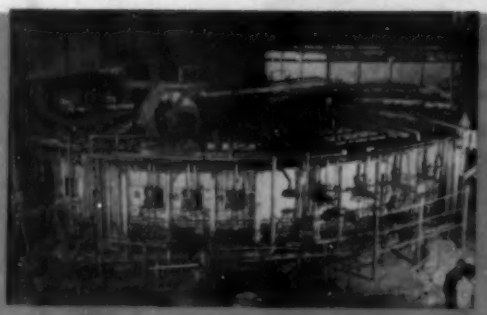
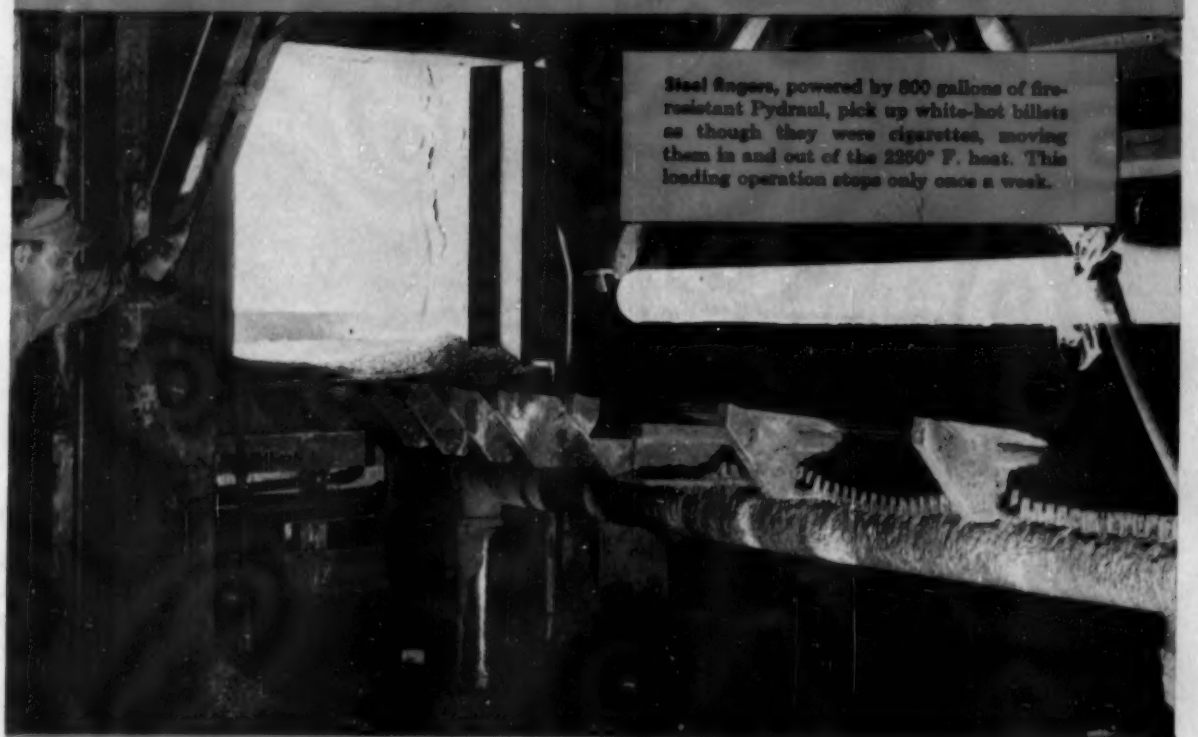


One line break with flammable fluid, causing a costly shutdown, moved Spang-Chalfant to switch to Monsanto Pydraul. Long-lasting and noncorrosive, Pydraul reduces make-up rates by as much as 80%.



Steel fingers, powered by 800 gallons of fire-resistant Pydraul, pick up white-hot billets as though they were cigarettes, moving them in and out of the 2250° F. heat. This loading operation stops only once a week.

PYDRAUL STOPS FIRES BEFORE THEY START

Monsanto Hydraulic Fluid Helps Steel Furnace Operate 160 Hours a Week

OPERATING CONTINUOUSLY to keep up with production schedules, this Hagan Rotary furnace at the Spang-Chalfant plant of The National Supply Company is equipped with a hydraulic loading boom actuated by fire-resistant Pydraul F-9.

BEFORE PYDRAUL F-9 was adopted, a line containing flammable fluid broke—shutting the furnace down for six hours. In addition to damage to electrical connections, the downtime was expensive in terms of lost production.

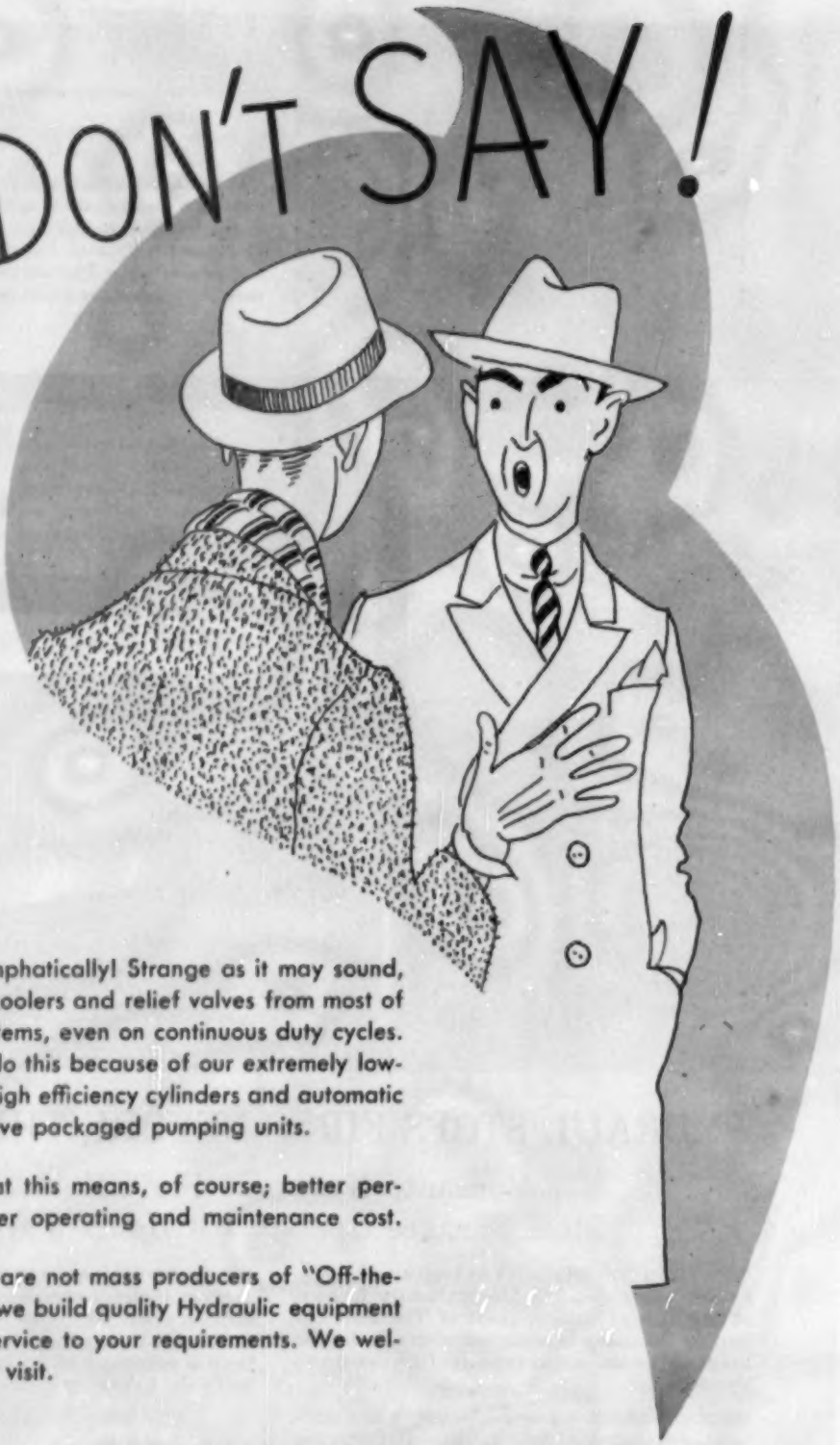
AFTER PYDRAUL WAS INTRODUCED, one incident demonstrated dramatically its fire-resistant properties. A ruptured hose connection sprayed Pydraul over hot billets and into the furnace door. This time, however, there was no damage to equipment or injury to personnel. Only a minimum of production time was lost while the hydraulic system was refilled.

Pydraul: Reg. U. S. Pat. Off.

Ask us for this booklet on Pydraul. *Write Organic Chemicals Division,* MONSANTO CHEMICAL COMPANY, *Box 478, St. Louis 1, Missouri.*

MONSANTO
CHEMICALS—PLASTICS

You DON'T SAY!



Yes, we say it emphatically! Strange as it may sound, we eliminate oil coolers and relief valves from most of our hydraulic systems, even on continuous duty cycles. We are able to do this because of our extremely low-leakage valves, high efficiency cylinders and automatic pressure responsive packaged pumping units.

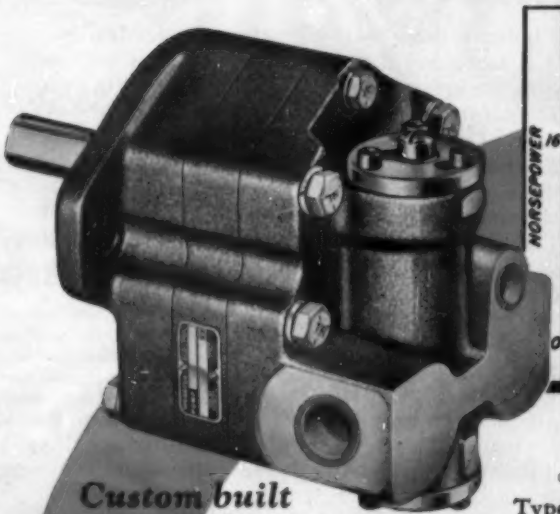
You know what this means, of course; better performance at lower operating and maintenance cost.

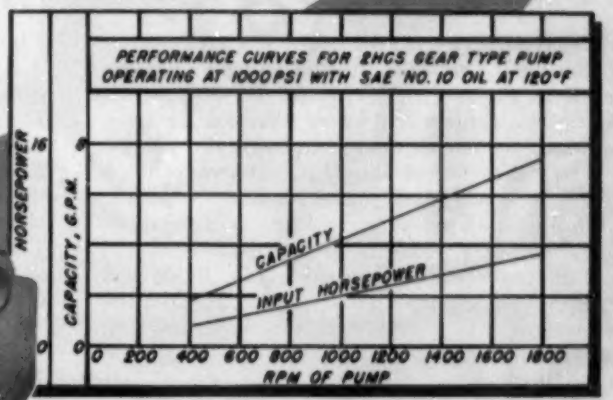
Remember we are not mass producers of "Off-the-Shelf" items . . . we build quality Hydraulic equipment for heavy duty service to your requirements. We welcome your call or visit.

Quality EQUIPMENT for *Quality* PERFORMANCE

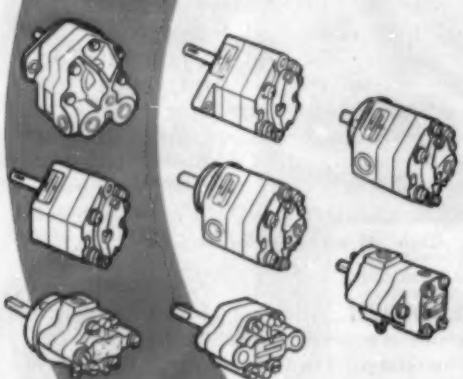
BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA.

Check this typical **WEBSTER** Hydraulic Pump Performance Curve





Custom built *for easy adaptation to your system*



• It will pay you to get the facts about WEBSTER Gear-Type Hydraulic Pumps before buying any pump. Here is a complete line of rugged, dependable pumps from 10 gph. to 10 gpm., engineered to operate efficiently at pressures up to 1200 psi. at speeds of 3600 rpm. or less—90 types of WEBSTER Oil Hydraulic Pumps of various designs and capacities to meet the widest range of requirements!

• WEBSTER pumps are the product of skill acquired during nearly a quarter-century of experience. They have established an enviable reputation for efficient, dependable operation. All WEBSTER pumps lend themselves readily to many forms of adaptation—and to modification for special installations. All are available with built-in relief valve, if desired.

• Whenever you require pumps for lubricating, oil circulating, filtering, transfer or quiet hydraulic power applications, we invite your inquiries.

Write *today for catalog containing performance charts and pump data sheets on which you can describe your requirements*

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MANUFACTURERS OF A COMPLETE LINE OF OIL HYDRAULIC PUMPS

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

HYDRAULIC PUMPS . . . The Dudco Division of the New York Air Brake Company, has released an 8 page bulletin No. DP-300, which points out features and gives selection data for the complete line of dual-vane hydraulic pumps. A series of technical drawings, cut-away photos and performance data charts illustrates the features of the pumps. All of the features of the dual-vane pump are outlined. Other sections of the bulletin cover mounting, hydraulic fluids and double pump capacity combinations. Installation dimensions are shown complete with drawing. Performance data is also included for the several different pumps.

Circle 151 on Reader Service Card

AIR AND HYDRAULIC CYLINDERS . . . A new bulletin # 800 has been prepared by the Air and Hydraulic Division of Lindberg Engineering Company. The standard catalog line of heavy duty air and hydraulic cylinders are described in detail along with the features of each. Descriptions of large, special custom built heavy duty air and hydraulic cylinders are also included.

Circle 152 on Reader Service Card

GAUGE SAVER . . . for protection of gauges, instruments and pressure elements in hydraulic or pneumatic systems is described in a bulletin S-214 released by Sprague Engineering & Sales Corp. Several sizes are available for pressure ranges from 10 to 5000 psi. The bulletin gives the features, specifications, adjustments and installation details. Additional features described is the automatic shut off of low range instruments, the protection of pressure elements from unusual surges and overrange protection of instruments in hydraulic systems. The method of just how the gauge saver operates is completely told. Service and maintenance instructions and mounting instructions are also included.

Circle 153 on Reader Service Card

HYDRAULIC SERVO VALVE . . . which is a two stage hydraulic valve employing a mechanical feed back and which can apply a force up to 150 pounds to clear any jamming is described in a bulletin prepared by Sanders Associates, Inc. It is explained that interfering particles such as wire, sludge or dirt are literally sheered in two. The torque motor is sealed against magnetic particles. The valve is illustrated in cut-away view. The sealed solenoids can be seen, also the pilot valve, control valve and the feed back arm. Dimensional data and specifications are included. The valve was designed for the transformation of low level electrical energy into controlled hydraulic energy.

Circle 154 on Reader Service Card

POWER TRANSMISSION EQUIPMENT . . . products of Lovejoy Flexible Coupling Co. are presented in an 8 page booklet. Featured are flexible couplings, variable speed pulleys and transmissions, and universal joints. Bore sizes of the flexible couplings range from solid to 9½ in with load ratings from fractional to over 800 hp. The smaller sizes are die-cast aluminum. The medium duty group are of high quality semi-steel, the heavy duty bodies are steel forgings or other equivalent metals. The load is transmitted by compression of the wear resistant cushion materials. Variable speed pulleys from ¼ to 8 hp and variable speed transmissions from ⅛ to 5 hp are completely described. A complete listing of the universal joints is given together with pertinent data.

Circle 155 on Reader Service Card

SWIVEL JOINTS . . . designed for high pressure hydraulic use are presented in Catalog No. 269, released by Barco Manufacturing Company. Features of these joints are self-alignment and vibration absorbtion. They are designed for 360 degree rotation. A cross sectional view shows the construction of the unit. Standard styles and sizes are illustrated showing installation dimensions for various sizes of tubing. Styles shown are standard and are suitable for a wide range of applications. Modifications can be made in standard designs, allowing for variations of dimensions and mounting brackets. This bulletin will be of assistance during preliminary design stages.

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For more reviews of Free Literature turn to page 122

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SAFEGUARDING INDUSTRY'S *Lifelines of Mobile Power*

specify **Eastman** *first in the field*

HYDRAULIC HOSE ASSEMBLIES

for the best performance, for long life and satisfaction—*all along the line*—from manufacturer to user. Check your needs on the following list:

COUPLINGS

Solid Male

Swivel Male

Swivel Female

STRAIGHT AND ANGLED ADAPTER UNIONS

Straight Male

90° Male

45° Male

Write for free catalog 103 on Eastman Hose Couplings and Bulletins 2318 & 2328 on Straight and Angled Adapter Unions.

how MASSEY-HARRIS *Hydraulic power* delivered through

Eastman *first in the field*

HYDRAULIC HOSE ASSEMBLIES

helps "KEEP 'EM DOWN ON THE FARM!"

EASTMAN Hydraulic Hose Assemblies on Massey-Harris Tractor.

Thanks to hydraulic power, many a man's job on the farm is a boy's job now! Fingertip hydraulic control does away with aching arms, dog-tired from day-long tugging at levers to raise and lower tillage tools.

Massey-Harris, shipping agricultural tractors and implements to 106 countries the world over, has developed some of the most ingenious hydraulic controls to meet the needs of modern contour farming—controls which not only do most of the hard work—*but do it automatically!*

EASTMAN Hydraulic Hose Assemblies carry oil at 1000 psi from the Massey-Harris 2-Way, 2-Speed *"Depth-O-Matic"* Hydraulic Control to raise and lower tractor mounted implements smoothly, easily, swiftly. Synchronized slave cylinders handle harrows, discs, plows.

Massey-Harris *"Selective Control"* maintains uniform cultivator penetration on hillside contour slopes, pictured above, through independent action of right and left gangs. *"Delayed Action"* permits raising front and rear gangs independently at contour points, also permits shovels to leave and enter soil at same point at ends of rows.

Other users of EASTMAN Hydraulic Hose Assemblies in the agricultural field include: Allis-Chalmers Mfg. Co.; J. I Case; John Deere Co.; The Farmhand Co.; Harry Ferguson, Inc.; Horn Manufacturing Co.; International Harvester Co.; Minneapolis-Moline Co.; Ottawa Steel Products Co.; Super-Six Manufacturing Co.; A. F. Wagner Iron Works.

Look to EASTMAN—first in the field—for continued leadership in "Safeguarding the Lifelines of Mobile Power"—in Industry and Agriculture!

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Dept. AH-3, Musktgwee, Wisconsin

What type of O-ring performs best?

Laboratory tests prove one type of O-ring seal has greater tensile strength and longer flexing life—injection molded O-rings produced by Minnesota Rubber. Why? Ordinary O-rings are compression molded—a process that forms extrusion or "flash" resulting in weakening trimming blemishes at the parting line and variations in the cross-section of the molded part.

Minnesota Rubber O-rings and custom molded parts are made differently. The exclusive injection molding process eliminates all machine trimming and rubber flash on the sealing surfaces. Constant result: O-rings and special rubber parts with smoother surfaces, tougher structure, higher density, longer life—with tolerances closer than ± .001 inch. The cost? Lower than the industry average!

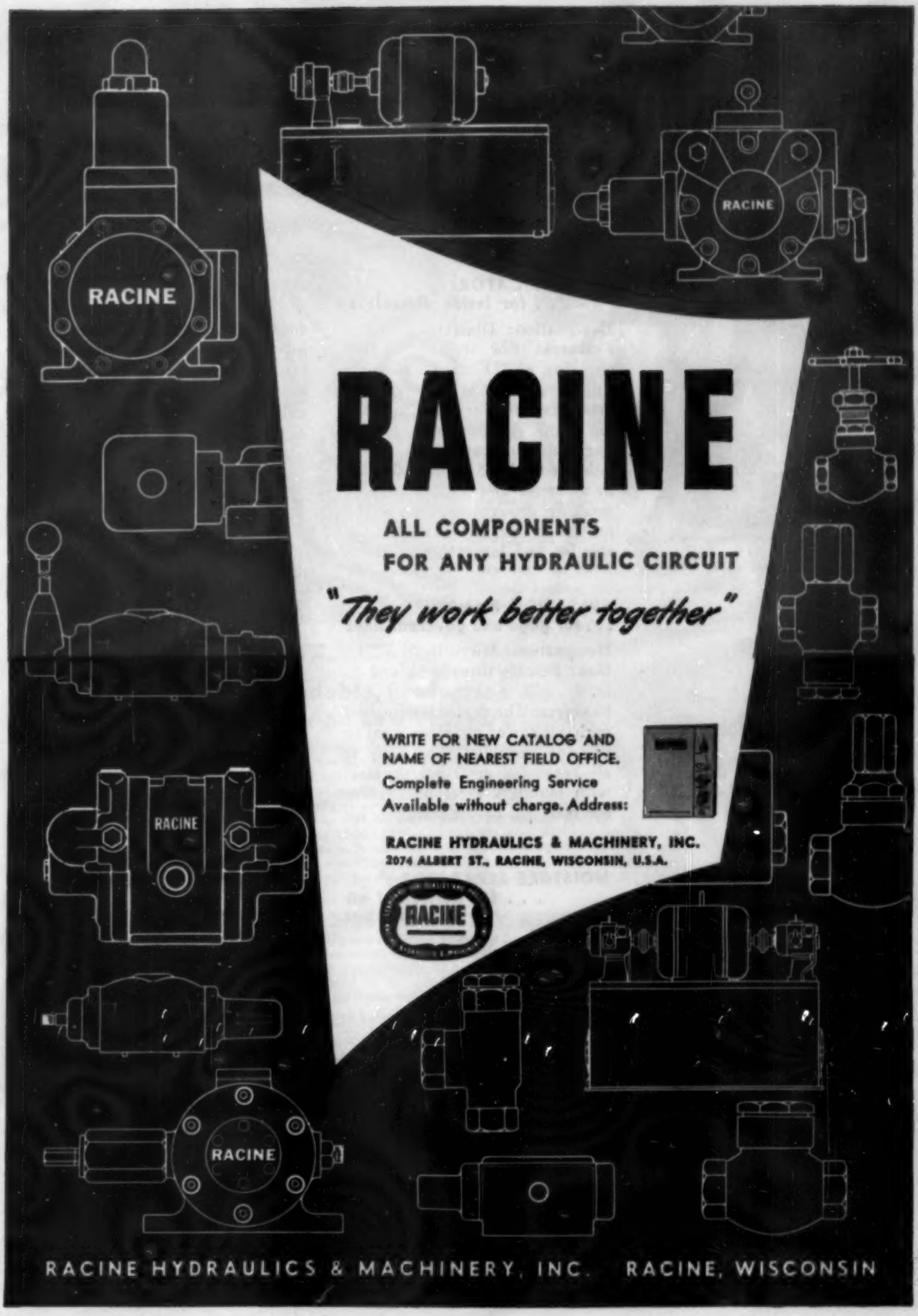
No matter how tough your O-ring problem, Minnesota Rubber will help you off the horns of your dilemma. Write today for complete details. Ask for the free catalog 9-B, "O-rings", for helpful information.

Minnesota Rubber and Gasket Company

3630 Wooddale Avenue, Minneapolis 16, Minn.

Dept. 301

Phone MOhawk 9-6781


RACINE
RACINE
RACINE

NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid pwer systems are described here . . . for more information fill in and mail the post card bound in this issue.

DIAL INDICATOR
. . . for inside diameters

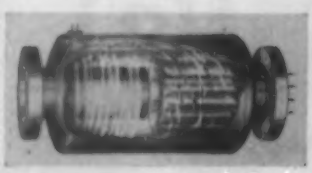
Designation: Diametrick
Features: For the improved checking of "O" ring and snap ring grooves. It is applicable to other inside diameters. Embodying some features of a height gage, the indicator will check holes from 1.375 in. to 3.625 in. in diameter and will expand to measure grooves as deep as ¼ in. Other sizes are available for smaller and larger bores. Inaccurate feel is replaced by positive indicator readings, easily set to masters, gage blocks, micrometers and snap gages. All bearings and adjustments are outside of work. It is useful also as a caliper in the tool room. It has extensive use by maintenance men in checking air and hydraulic cylinders for replacement parts.

Mutual Engineering Service, Saginaw, Michigan
Circle 201 on Reader Service Card

PULSATION DAMPENER
. . . for gage and governor lines

Designation: Micro-Bean
Size: Female threads ¼ and ½ in.
Features: The device is equipped with a filter of stainless steel to prevent corrosion. The body is all brass for 3000 psi or steel with stainless steel microvalve for 6000 psi or all stainless for 10,000 psi. The valve has a 96 to 1 taper to eliminate stem and screw compression strain. When installed ahead of a gage or governor, jitters of the gage pointer are minimized, pulsation is dampened and the line flow is smoother.

J. A. Campbell Company, Long Beach 7, Cal.
Circle 202 on Reader Service Card



MOISTURE SEPARATOR
. . . for horizontal air and gas lines

Designation: 31-N
Design: Installs in minimum space, occupying scarcely more than the section of pipe it replaces. Is self cleaning and may be used with a wide range of pressure. Construction is fabricated steel. Centrifugal force principal is applied in the separator for removing entrainment.

Wright-Austin Company, Detroit 7, Mich.
Circle 203 on Reader Service Card

CONTROL VALVE
. . . for gas pressure bottles

Designation: MV 57
Features: The valve is an internally piloted, high capacity, 5 in 1 control valve, featuring on-off pressure relief, drain, gauge and check operations in one unit, instant reaction at working pressures to 350 psi. **Specifications:** Air pressure 3500 psi, operating temperature −65 to 165 degrees, pressure relief blows off at 3500 psi and resets at 3100 psi and the pressure relief valve is provided with manual water drain.

Maretta Valve Corp., Boonton, New Jersey
Circle 204 on Reader Service Card

When Hydraulic Muscles Handle The World's Heaviest Agriculture Crops

THOMSON HURRYCANE LOADER—by Thomson Machinery Co. Inc., Thibodaux, La. Leaders in the design and manufacture of this type of equipment for over 30 years.

Engineers Depend on

MARVEL SYNCLINAL FILTERS

The problem of maintaining clean oil for the vital hydraulic system of Thomson Hurrycane Loaders was solved with the installation of Marvel Synclinal Filters as standard equipment.

The loading of sugar cane, with yields of 20 to 30 or more tons per acre puts this equipment to a severe test. In many cane growing areas, leaves are burned from the cut cane before it is transported to the mill, leaving a sooty residue which envelops the equipment in such a fog of dust that operators are forced to wear respirators.

Furthermore, Thomson Loaders are used in cane growing countries throughout the world including equatorial areas where constant and excessive high temperatures further complicate hydraulic problems.

Marvel Synclinal Filters have proven their ability to perform this double duty in the efficient filtration of hydraulic oil under such adverse conditions.

SUMP TYPE (Cutaway)

For Dependable Protection On All Hydraulic And Low Pressure Liquid Systems

The BALANCED Synclinal Design of Marvel Filters provides that all-important balance between maximum active filtering area and sufficient capacity for storage of filtered out particles. In the plants of America's industrial giants as well as in smaller plants, Marvel Synclinal Filters are doing an excellent job protecting machines and increasing production. They are proving their superiority in the one real test—ON THE JOB! Marvel Synclinal Filters operate longer between cleanings, require less attention, reduce down time, and in short, achieve more production with less maintenance. Not only plant operators, but also over 400 manufacturers of machines have recognized the superiority of Marvel Synclinal Filters and now install them as original equipment.

LINE TYPE (Cutaway)

A SIZE FOR EVERY NEED

For filtering in hydraulic and other low pressure oil systems. Sump and line type models available in capacities from 5 to 100 g.p.m., and in mesh sizes ranging from coarse 30 to very fine 200. All models may be quickly disassembled, cleaned and reassembled on the spot by any workman. Line models operate in any position and are easily serviced without disturbing pipe connections.

IMMEDIATE DELIVERY

Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY. If desired, shipments are made the same day orders are received.

WATER FILTERS

In response to the great demand, we have adapted both our sump and line type models for use in all water filtering applications. No changes have been made in the basic synclinal design.

MARVEL *Engineering Company*

Meets J.I.C. Standards

625 WEST JACKSON BLVD., CHICAGO 6, ILLINOIS
Phone Franklin 2-4431

MARVEL ENGINEERING COMPANY AH-3
625 W. Jackson Blvd., Chicago 6, Ill.

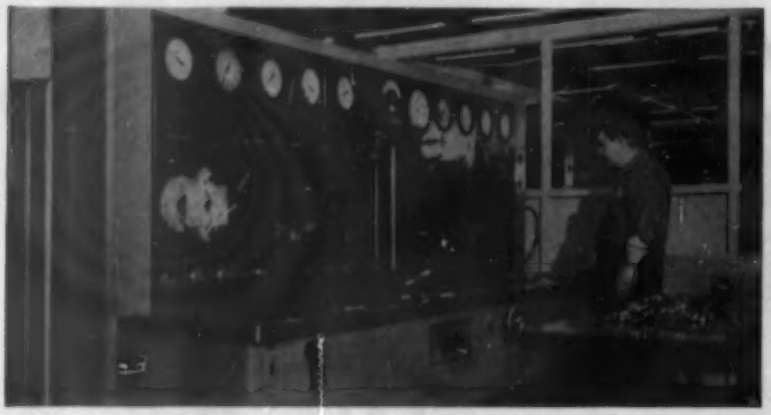
Without obligation, please send me complete data on Marvel Synclinal Filters as follows:

Catalog #106 for Oil Filters
Catalog #300 for Water Filters

Name .....
Company .....
Address .....
City ..... State .....

GREER TOPICS

Important News of Aviation & Industrial Test Equipment



Greer Stationary Hydraulic Accessories Test Stand, shown here in Ford's Kansas City Aircraft plant, provides a shop type machine to fully check hydraulic system accessories including system pump at flow rates up to 20gpm and at pressures up to 3400psi.

Greer Dual Hose Tester, used for B-47 hose lines, checks from one to six hose lines or similar production components with pressures to 25,000psi in covered burst chamber.

Greer Portable Hydraulic Test Machine provides hydraulic test fluid for checking hydraulic systems of modern aircraft. Handles flows up to 20 gpm and pressures up to 3400psi.

How Greer Helps Ford

Greer Test Machines check complex B-47 components at Ford's Kansas City plant

This year is the fiftieth anniversary of the Ford Motor Company. Their entire history is one of quality products, economically produced. One of the reasons for Ford's extraordinary record has been its high standards of quality control.

To help maintain these high standards in the manufacture of aircraft components, Greer test equipment is at work in Ford's Kansas City aircraft plant. Complex B-47 components are put through rigorous inspection to determine their air-worthiness.

Walk into virtually any plant in the aircraft industry and you'll find Greer equipment at work. Most of the units are standard equipment ordered directly out of a catalog (yours on request). Other units were specially built to out-of-ordinary specifications by the famous Greer engineering department. These men are ready to go to work for you.

GREER TEST EQUIPMENT

Greer Hydraulics Inc. 454 Eighteenth Street, Brooklyn 15, New York

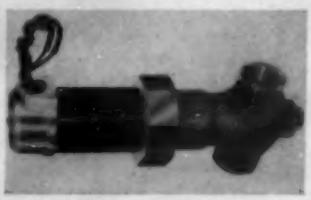
Field Offices: 1908 West Cermak Road, Chicago, Illinois • 25 South Main Street, Dayton, Ohio 2832 East Grand Boulevard, Detroit, Michigan • and sales representatives in all principal cities

New Products

Continued

SOLENOID VALVES
. . . in cast iron and cast steel

Size: ½ to 2 in.
Design: Designed for handling all media normally injurious to bronze or brass not harmful to ferrous metals. Features include stick-free internal design, stain-



less steel hooded pilot seat screw for more positive closing action and Teflon disks to all media except hot flourine. Removable inserts are used throughout the complete range of sizes. Neoprene "O" rings seal joints and prevent leakage. Pressures range to 1000 psi at 200 F. and 500 psi at 450 F.

Atkomatic Valve Company, Indianapolis 25, Indiana
Circle 205 on Reader Service Card

HIGH SPEED REVOLVING JOINT
. . . for use on brakes and clutches

Size: ¼ in. straight threads.
Design: Consists of only seven

parts. It contains a high speed bearing lubricated for life. Low turning torque; rotating seal is nonporous, heat treated carbon. The stationary seal is a standard oil resistant "O" ring.

Retherm Engineering Company, Inc., Chicago 31, Ill.
Circle 206 on Reader Service Card

For more New Product Information turn to page 104

FREE USEFUL LITERATURE

Pressure Switch Selection Chart provides an easy method of finding a pressure switch for your specific application. This tabulation helps you define your requirements and saves you time in finding the correct switch for your job.

Check number M3 on the coupon below.

Piston Pressure Switch bulletin describes in detail the entire service range from 15 to 3000 P.S.I. (7000 P.S.I. proof pressure). Belongs on Production Equipment, where millions of cycles are expected, and on Original Equipment, where flexibility and price are vital factors.

Check number 9612 on the coupon below.

Bourdon Tube Switches for pressures to 12000 P.S.I., single setting, housed models and skeleton models are covered in detail in these pages.

Check number 312 on the coupon below.

Diaphragm switches for vacuum and pressures to 120 P.S.I., single setting, are fully described and illustrated in this bulletin, complete with tabulation of Adjustable Ranges and Actuation Values.

Check number 420 on the coupon below.

The "Shear-Seal" Principle is a revolutionary twentieth century advancement in valving extreme pressures as well as low pressures and vacuum. The only known method to achieve leakproof closure and maintain or improve sealing qualities with use. This patented principle is illustrated and discussed in a comprehensive bulletin.

Check number BV-2 on the coupon below.

Solenoid "Shear-Seal" Valve Catalog gives complete information on line of shut-off, diverter, 3-way and 4-way selector, and 3 position selector valves for Air, Water, and Oil Service to 3000 P.S.I.

Check number 1B-2 on coupon below.

Solenoid Air Valves, the famous Crescent 3-way and 4-way valves, are catalogued with complete technical description in this eight page brochure. Where long service without valve maintenance or solenoid trouble is essential, these valves have become standard.

Check number 3C-1 on the coupon below.

New 20 page catalog includes all basic information on Barksdale Manual Shear-Seal valves, Solenoid Shear-Seal valves, Meletron Pressure Switches, and Crescent Air Valves.

Check number 3G on coupon below.

Barksdale Valves

5125 Alcoa Ave. L. A. 58, Calif.

M3 ☐ 9612 ☐ 312 ☐ 420 ☐

BV-2 ☐ 1B-2 ☐ 3C-1 ☐ 3G ☐

Name _____ Title _____

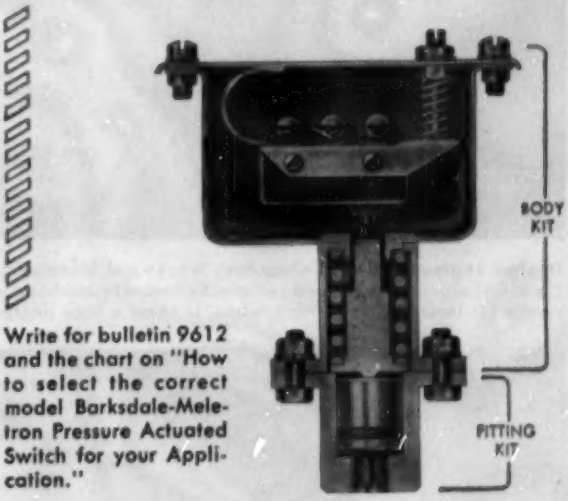
Company _____

Address _____

City _____ Zone ____ State _____

MODEL 9612 PRESSURE SWITCH

It belongs where millions of cycles are expected, on production equipment, where service troubles are taboo. The original equipment manufacturer can profit by these additional advantages: Extreme flexibility — the same body kit converts to an infinite number of service conditions by simply changing fitting kits. High proof pressure even at low settings — protection against surge damage. No unwanted actuation from vibration or harmless line surges. Switch may be mounted in any position — no levelling or balancing required. Mounting bracket adjustable up and down and 360° around the neck of the switch. Tamperproof external adjustment. All this and more at a low price, due to production savings without sacrifice of quality.

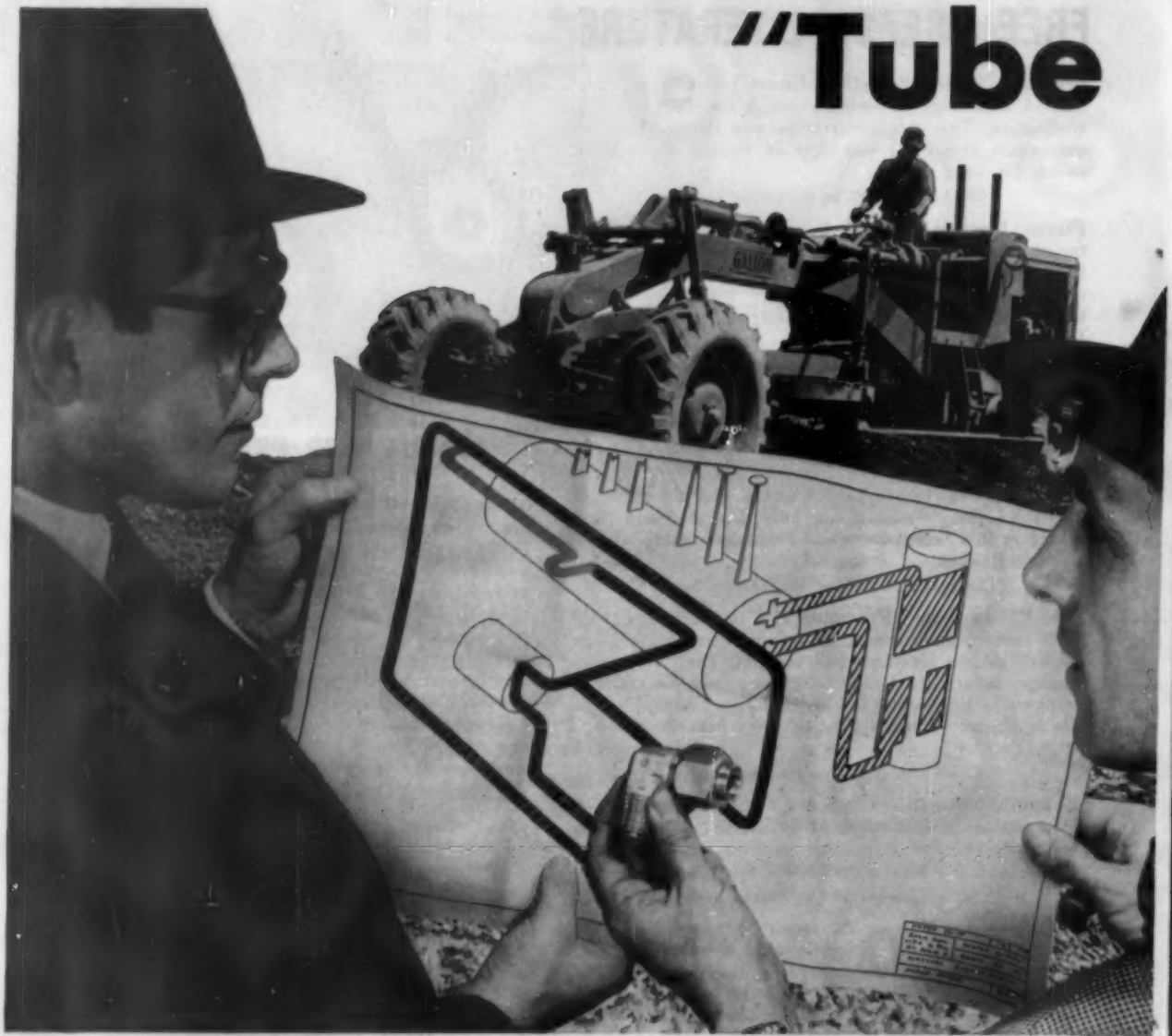


Write for bulletin 9612 and the chart on "How to select the correct model Barksdale-Meletron Pressure Actuated Switch for your Application."

BARKSDALE VALVES

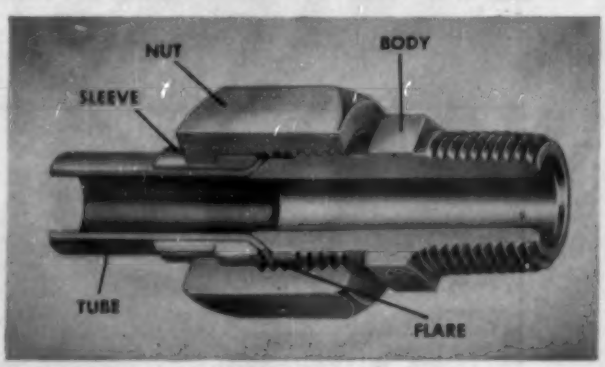
5125 Alcoa Avenue, Los Angeles 58, Calif.

"Tube



Design engineers at the Galion Iron Works and Manufacturing Co. of Galion, Ohio, developed a simple, foolproof hydraulic control system for their line of motor graders. It offers a high degree of accuracy, safety, and dependability and has proved to be an outstanding success. One reason: Galion engineers specified Parker *Triple-lok* fittings for every grader they build.

At tube-bursting pressures Parker *Triple-lok* fittings remain intact with absolutely no leakage or distortion. They also hold leakproof over ranges of extremely hot and cold temperatures.



3-piece *Triple-lok* fittings are stocked by distributors in steel, stainless steel, brass and aluminum alloy. They are also available in other materials on special order.

up and forget it"

Use leakproof Parker *Triple-lok* fittings for trouble-free equipment

This motor grader, like most mobile equipment, takes severe punishment during its daily work. Jars and jolts; stresses and strains! Hydraulic control systems must be extra safe and dependable. That's why more and more manufacturers of lift trucks, agricultural and earth-moving machinery are specifying leakproof Parker *Triple-lok* fittings.

These flare fittings are absolutely leakproof even under the severest conditions of vibration, shock, and hot and cold temperatures. Thousands of destruction tests prove they will hold pressures that burst the tubing.

Using *Triple-lok* fittings is the easiest and best way to tube up your equipment. You get low assembly torque, easy disconnection, and repeated reassembly for trouble-free joints.

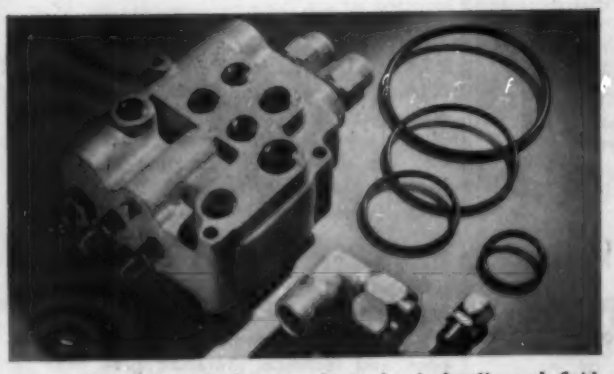
These fittings meet J.I.C. and S.A.E. standards plus specifications of the A.S.M.E. Code for Pressure Piping.

As a matter of fact, *Triple-lok* is the standard of industry. More *Triple-lok* fittings are used on industrial machinery than any other fitting.

So, tube up and forget it. Specify *Triple-lok* fittings for the equipment you build. Parker offers the widest range of shapes and sizes available . . . for tubing outside diameters from ⅛ through 2 inches. Mail the coupon for complete fitting data.

TUBE AND HOSE FITTINGS DIVISION
The Parker Appliance Company
17325 Euclid Avenue, Cleveland 12, Ohio

Parker
Hydraulic and fluid system components



What other Parker products for hydraulic and fluid systems interest you? Ferulok flareless fittings? New hydraulic control valves? Synthetic rubber O-rings?

TUBE AND HOSE FITTINGS DIVISION
The Parker Appliance Company
Section 403-P
17325 Euclid Avenue
Cleveland 12, Ohio

☐ Please send Parker fittings catalog No. 4300
☐ Please send descriptive literature about . . .

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

Mail this coupon for catalog of complete information about Parker tube fittings . . . the standard of industry. If you'd like to know about other Parker products, please list them on the coupon.

Circle 97 on Reader Service Card

SOLVED...

The Problem of Driving the Pump from a Reversing Shaft without Changing Direction of Flow or Port Positions

New Tuthill Catalog No. 105 Provides the Facts You Need on Automatic Reversing Pumps

How to lubricate reversing machinery! How to provide coolant or hydraulic power when the pump must be driven from a reversing shaft! How to insure pump flow in the proper direction on machinery which must be shipped without knowing the ultimate direction of the driving members!

The answers to questions like these are presented in this new Catalog No. 105 on Tuthill Automatic Reversing Pumps. Through a unique feature developed by Tuthill, these pumps can be driven in either direction of rotation without changing direction of flow or port positions. The wide range of types, sizes, and pressures makes these pumps readily adaptable to your requirements. Capacities up to 200 g.p.m. and pressures to 400 p.s.i.

Write for your copy of Catalog No. 105 today

TUTHILL PUMP COMPANY
Dependable Rotary Pumps since 1927
939 East 95th St., Chicago 19, Ill.

Canadian Affiliate: Ingersoll Machine & Tool Co., Ltd. Ingersoll, Ontario, Canada

Free Literature Offered in This Month's Ads

For more information circle numbers on the reader service card bound in this issue.

MOLDED PACKINGS and the engineering standards are described in manual MP-200, offered by Greene, Tweed Co. Packing design and performance are explained.
Circle 55 on Reader Service Card

AIR and HYDRAULIC CONTROL VALVES are described in data sheets which are available from C. B. Hunt & Son, Inc.
Circle 64 on Reader Service Card

HYDRAULIC TUBING with complete information on analyses, sizes, lengths, properties and working pressures is all available in Bulletin 38 offered by Superior Tube Company.
Circle 118 on Reader Service Card

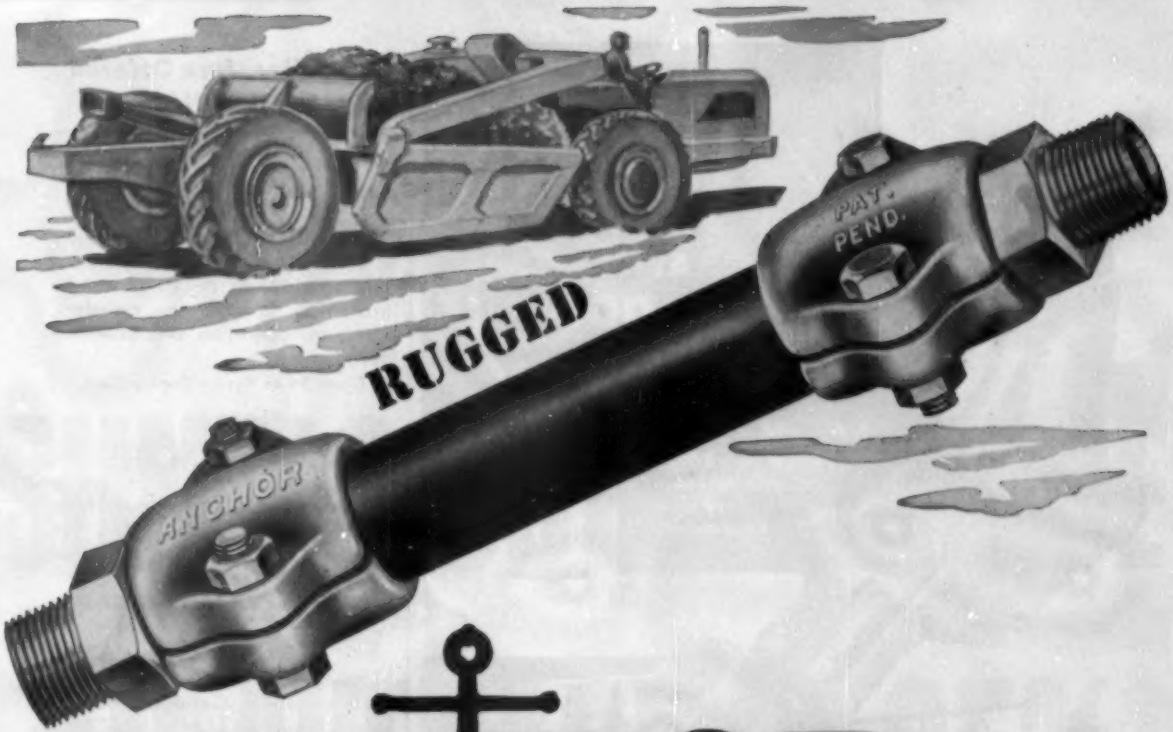
CONTROLLED REGULATION with solenoid valves, adjustable flow regulators, check valves and unloading valves are described in an illustrated circular A, by Waterman Engineering Company.
Circle 132 on Reader Service Card

HEAT EXCHANGERS both shell and tube are presented in catalog form by Young Radiator Co.
Circle 136 on Reader Service Card

DRYSEAL-THREAD PRESSURE PLUGS, that seal tight without compound, are described in literature offered by Standard Pressed Steel Co. The design and operation of these plugs is explained.
Circle 117 on Reader Service Card

IMPREGNATED LEATHER PACKINGS, their advantages and features are discussed in an engineering hand book and technical literature prepared by C. W. Marsh Company.
Circle 79 on Reader Service Card

Continued on page 22



ANCHOR

CLAMP-TYPE REUSABLE COUPLINGS

— ideal for heavy-duty original-equipment service or emergency repairs in the field

For high or medium pressures—can be used with one- or two-wire braid hose.

Specially designed clamping segments — impulses can't shake them loose, yet coupling is reusable again and again.

Easy to apply — no special tools needed to assemble couplings and hose. Hose cover need not be stripped to apply coupling.

Neat Installation — made possible by compact design of the Anchor clamp and the use of streamlined Anchor adapter unions and related fittings.

Saves Time — you don't have to wait for repairs because you can make up your hose lengths as needed. Stocking problem minimized.

NEW!
REVOLUTIONARY
ANCHOR FLANCO
SPLIT-FLANGE CLAMP
Positive leakproof connection without threaded joints. Bolt centers are located to distribute the forces evenly and prevent tilting of the clamp halves. Easy to assemble with small automotive-type wrench.

Get more details. Attach coupon to your letterhead and mail today.

ANCHOR COUPLING CO. INC.

Main Office and Factory: LIBERTYVILLE, ILLINOIS

FACTORY BRANCHES: DETROIT, MICHIGAN • DALLAS, TEXAS

9-14

Anchor Coupling Co. Inc.
Dept. AH-34, Libertyville, Illinois
I'd like to know more about
☐ Anchor clamp-type reusable couplings
☐ New Anchor Flanco Split-flange clamp-type coupling
Send me detailed information.

Name..... Title.....

Company Name.....

Company Address.....

City..... ( ) State.....

Qualifying for use on Air Force and Navy aircraft, this 3,000 lb. MIL-AN-6248 hydraulic hand pump, manufactured by GLADDEN PRODUCTS CORP., 635 W. Colorado, Glendale 4, Calif. underwent a test of 70,000 full cycles—only one change of "O"-Rings was allowed, and volumetric efficiency had to stay at not less than 75%. *The pump, however, equipped with Parco "O"-Rings, finished the rigorous test with a remarkable efficiency rating of 97.8%—with no change of "O"-Rings!* Another example of the extra durability of Parco "O"-Rings—it pays off in better products, greater efficiency and lower costs! All dash numbers of AN 6227, AN 6230, AN 6290, MS 29512 and MS 29513 series for commercial or Army-Navy installations to Specifications MIL-P-5516A, MIL-G-5510A and MIL-P-5315A are available from stock. Silastics and other special compounds supplied on order.

New 8-page catalog and engineering data on request. Write us today.

Parco

PLASTIC AND RUBBER PRODUCTS CO.

2100 Hyde Park Boulevard, Los Angeles 47, California
3140 West Irving Park Road, Chicago 18, Illinois

Circle 101 on Reader Service Card

Free Literature Offered in this Month's Ads

Continued

HYDRAULIC CYLINDER Bulletins H-104 and A-105 are available from Miller Fluid Power Co. Complete information is given on cylinders, bores, psi operation and mounting styles.

Circle 84 on Reader Service Card

AIR CYLINDERS, their design and construction are fully described in a catalog available from Air-Mite Industrial Air Equipment, Inc. The cylinders are made in single or double acting series.

Circle 3 on Reader Service Card

STEEL HYDRAULIC COUPLINGS are covered in Catalog #53, released by L & L Mfg. Co. New products also covered are needle valves, ball check valves, swivel elbows and pipe nipples.

Circle 73 on Reader Service Card

ONE WAY IMPULSE SWITCH for simplified control is the subject of Bulletin ESF-3, released by Electro-Snap Switch & Mfg. Co.

Circle 39 on Reader Service Card

BALL BEARING SWIVEL JOINTS are described in a catalog available from Chiksan Company.

Circle 25 on Reader Service Card

THREAD PROTECTORS, their uses and applications are detailed in a catalog offered by CaPlugs Division, Protective Closures, Inc. The catalog, price lists and free CaPlug assortment can be obtained from the company.

Circle 105 on Reader Service Card

HYDRAULIC CYLINDER line of The S-P Mfg. Corp. is covered in catalog No. 103. Catalog 102 covers their air cylinder line. Information can also be obtained on other company products, such as power checks, rotating air cylinders, expanding arbors, air valves and pistons.

Circle 111 on Reader Service Card

Continued on page 24

In hydraulic systems

SUNTAC CUTS LEAKAGE AN AVERAGE OF 35%

This amazing average has been established by years of extensive use in many different industrial hydraulic systems. And results are immediate—leakage is reduced as soon as Suntac Oil is put in the system.

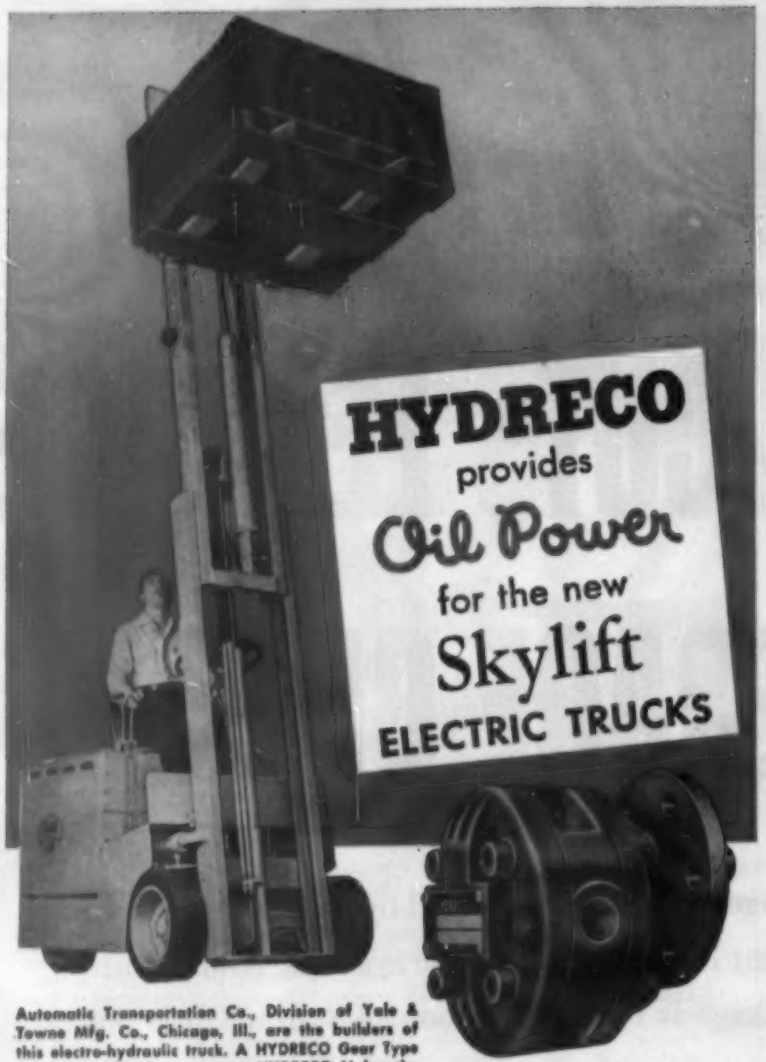
For information about Suntac for your specific application, telephone your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Department AH-3

INDUSTRIAL PRODUCTS DEPARTMENT

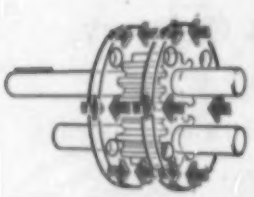
SUN OIL COMPANY

SUNOCO

PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL



Automatic Transportation Co., Division of Yale & Towne Mfg. Co., Chicago, Ill., are the builders of this electro-hydraulic truck. A HYDRECO Gear Type Pump provides the power, a HYDRECO Valve the control, for raising the forks and tilting the mast.



Pressure compensated wear plates maintain a fixed clearance between wear plates and gear faces regardless of pressure. This feature in HYDRECO Pumps and Motors minimizes oil slippage and power loss... volumetric efficiency and mechanical efficiency remain high!

It is significant that more and more design engineers turn to HYDRECO Components for the sound answer to the problem of "the right" 1000 to 1500 psi hydraulic circuit for any kind of mobile equipment, machine tools or special machinery. This preference stems from three obvious advantages: 1. Simple, easily serviced Four Bolt design in Pumps and Motors; 2. Hollow Plunger Valves for smooth finger-tip control; 3. Definite economies in first cost and maintenance. Thus HYDRECO *Oil Power* finds favor with the engineer, the operator AND the man who pays the bills.

Write for special brochures on HYDRECO Pumps, Motors, Valves and Cylinders today!

HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
1104 EAST 222nd STREET • CLEVELAND 17 • OHIO

Circle 67 on Reader Service Card

Free Literature Offered in this Month's Ads

Continued

HYDRAULIC EQUIPMENT folder which is illustrated and released by Warner Division of Detroit Harvester Co. of N. Y. Inc., shows typical examples of the company's hydraulic equipment. The company says that "if you use hydraulics, you need this folder."

Circle 131 on Reader Service Card

HOSE COUPLINGS and adapter unions are described in a catalog prepared by Eastman Manufacturing Company. Catalog 103 covers hose couplings and 231B and 232B, the straight and angled adapter unions.

Circle 38 on Reader Service Card

FLUID LINE COUPLINGS which are quick-connective is presented in catalog form by The Hansen Manufacturing Company. The one-way and two-way shut-off types are described together with the straight-through quick-connective couplings.

Circle 61 on Reader Service Card

MECHANICAL DATA BOOK for hydraulic valves and pumps is offered by The Fulflo Specialties Co., Inc.

Circle 45 on Reader Service Card

MAGNETIC SEPARATOR which is a part of the Ferro Filter made by S. G. Frantz Co. Inc., is described in Bulletin PM-65. How hydraulic systems are protected is presented.

Circle 44 on Reader Service Card

ROTARY COMPRESSORS and VACUUM PUMPS are described in literature and engineering data offered by Fuller Company. The features and advantages of their products are given, such as the direct drive and vibrationless design.

Circle 46 on Reader Service Card

"UCON HYDROLUBES", F-7380 is a booklet available from Carbide and Carbon Chemicals Co. This is a hydraulic fluid that contains water for non-flammability.

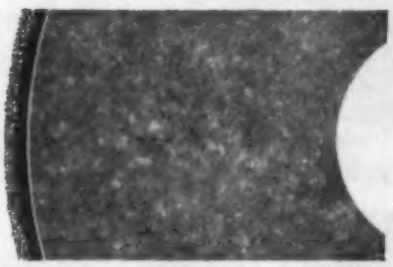
Circle 20 on Reader Service Card

Continued on page 26

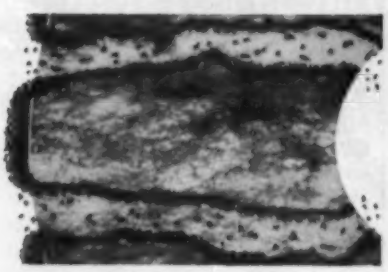
GRADUATED DENSITY

makes MICRO-KLEAN the most effective filter on the market!

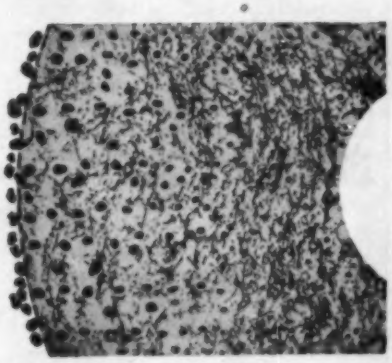
How MICRO-KLEAN compares with other cartridge filters



Compare MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT. The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



Compare MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA. Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



Now Look at the advantages offered by MICRO-KLEAN. See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN'S graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2⅛" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- greater dirt holding capacity
- absolute protection against rupturing or channeling of the cartridge
- longer effective cartridge life

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

CUNO *ENGINEERED FILTRATION*

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

GET ECONOMICAL FILTRATION IN YOUR HYDRAULIC SYSTEMS

MICRO-KLEAN lasts twice as long as ordinary cartridge-type filters

If you're interested in economical, effective filtration for a hydraulic system, take a look at a Cuno MICRO-KLEAN filter.

MICRO-KLEAN's high porosity gives you low-pressure-drop filtration on either the high or low pressure side of pumps. Moreover, Cuno's exclusive method of felting fibers results in great structural strength and graduated density in depth. This gives the MICRO-KLEAN much greater capacity for dirt accumulation plus complete protection against channeling, shrinkage, rupture, or distortion. Result: twice the useful life of an ordinary filter element.

That means you have to replace a MICRO-KLEAN cartridge only half as often as most others. And changing cartridges takes only a few seconds—one nut is all you have to remove.

Any MICRO-KLEAN will remove 100% of all solids for which it's rated* plus a large percentage of particles down to 1 micron. Capacities range from a fraction of a gallon to over 800 gallons per minute. Mail the coupon for our free filtration analysis form.

*15,25,50 microns M.3.19

Cuno Engineering Corporation
Dept. 3519D South Vine St., Meriden, Conn.

Please send me your filtration analysis form —and more information on MICRO-KLEAN.

Name.....

Company.....

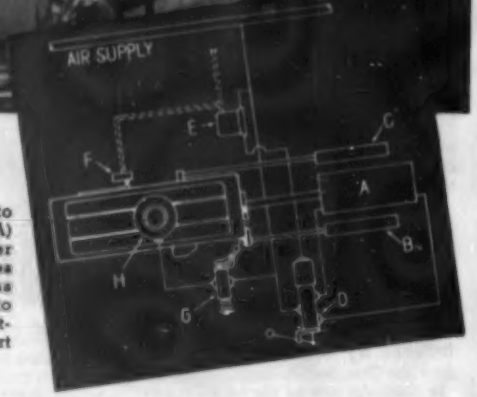
Address.....

City.....Zone....State.....

LET **Valvair** *Substitute Air for Muscle!*

Slot-milling on Horizontal Milling Machine

Move lever of Valvair (D) to start cycle. Air cylinder (A) advances table to work. After cut, limit switch (F) actuates pilot valve (E), which returns valve (D) and cylinder (A) to starting position. Cam-operated Valvair (G) indexes part for next cut.



All air control valves and the installation are by Valvair. Valvair's basic body design fits nine control assemblies. Internal parts are also interchangeable. Valvair *Diversatility* puts real flexibility into your plant operation. Let Valvair engineers or your local Valvair representative assist with your pneumatic circuit problems.

★ ★ ★

The Valvair Speed King line is complete — 3-way, 4-way, 4-way-5-port (2-pressure), foot-mounted or sub-base manifold mounted; pipe sizes — ⅛", ¼", ⅜", ½", ¾", 1". A precedent-breaker in size, weight, speed and endurance.

"Cut it out!"

☐ ☐ MORE INFORMATION ON VALVAIR LINE
☐ BULLETIN "A-3" ON NEW SOLENOID PILOT VALVE

Name, title_____
Company_____
Address_____

VALVAIR CORPORATION, 951 Beardsley Ave., Akron 11, Ohio

Valvair DIVERSATILITY

Circle 128 on Reader Service Card

Free Literature Offered in this Month's Ads

Continued

HYDRAULIC PUMPS and MOTORS are covered in literature available from Gerotor May Corp. The principle of the pumps and motors is explained and how they maintain high volumetric and mechanical efficiency.

Circle 53 on Reader Service Card

PACKINGS and GASKETS and how they aid in new equipment design are discussed in Booklet Pk-58A, offered by Johns-Manville.

Circle 70 on Reader Service Card

AIR OPERATED DEVICES are described in a new colored industrial air power catalog available from Mead Specialties Co.

Circle 83 on Reader Service Card

PUMPS, MOTORS, VALVES and CYLINDERS are completely described in special brochures available from Hydreco Division, The New York Air Brake Company.

Circle 67 on Reader Service Card

PACKING is offered for air and hydraulic cylinder applications and the literature explains how fluid slippage is virtually eliminated. The bulletin is filled with helpful data and is available from Darling Valve & Manufacturing Co.

Circle 31 on Reader Service Card

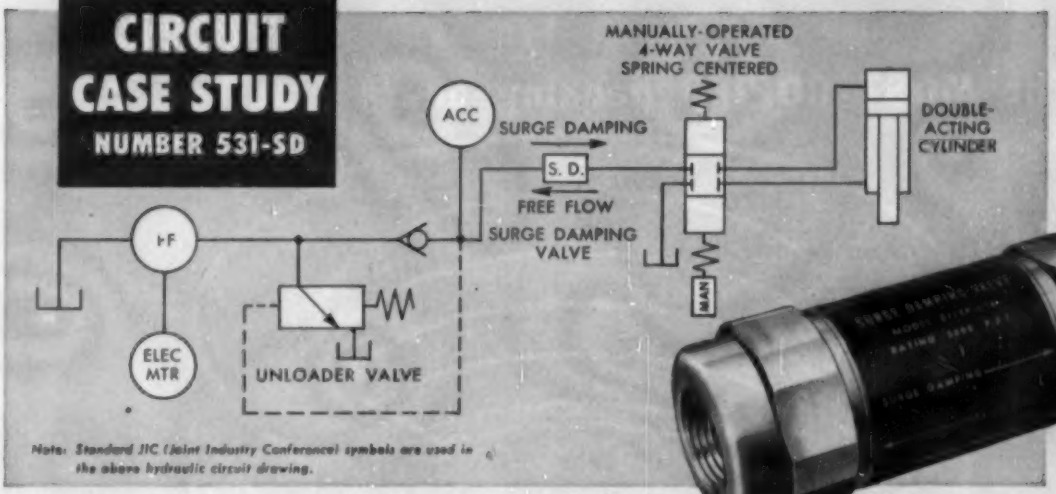
COMPLETE LINE OF CYLINDERS is presented in a bulletin by Anker-Holth, Division of The Wellman Engineering Company.

Circle 10 on Reader Service Card

VALVES and PRESSURE SWITCHES are covered in several useful pieces of literature by Barksdale Valves. Subjects of the bulletins are pressure switch selection chart, piston pressure switch, variable actuation value switch, the "shear-seal" principle, solenoid "shear-seal" valve, solenoid air valves, and a new 20 page catalog which includes all basic information on other valves and switches available from the company.

Circle 14 on Reader Service Card

CIRCUIT CASE STUDY NUMBER 531-SD



Note: Standard JIC (Joint Industry Conference) symbols are used in the above hydraulic circuit drawing.

½ ACTUAL SIZE

DENISON Surge-Damping Valve

prevents destructive, noisy *shock* in hydraulic systems

Fast operating at pressures up to 5000 psi without loss of cycle time

The circuit above shows a typical way to provide for intermittent ram action.

A relatively small pump is used, as reserve pressure is stored in the accumulator between applications of ram effort. When pressure in the accumulator reaches a preset maximum, the unloader valve diverts pump volume to the reservoir at negligible pressure.

Shifting the control of the four-way valve causes the ram to descend on the work, instantly utilizing reserve pressure from the accumulator. Ordinarily, this sudden extra volume and pressure produces hydraulic shock, which causes excessive noise and is apt to damage piping joints and seals.

The Denison **Surge Damping Valve** *prevents*, rather than absorbs, this hydraulic shock. It is a normally closed valve, but when line pressure is directed toward the inlet side, it allows a gradually increased flow of oil until fully opened. Then virtually free flow is maintained until oil flow is interrupted—no matter how briefly. The valve then resets instantly, ready for the next ram action.

Operation is simple and positive. The valve body houses a close-fitting spool which must move against and displace a cushion of oil to permit flow through the valve. As the surge of pressure strikes the spool, oil in the cushion escapes through a small orifice. Oil rushing out of this orifice is directed against a normally open flow control device. This flow control is hydraulically unbalanced; therefore, it tends to close under this pressure—the higher the surge pressure, the greater the throttling effect. In other words, speed of valve opening is inversely related to surge pressure increase.

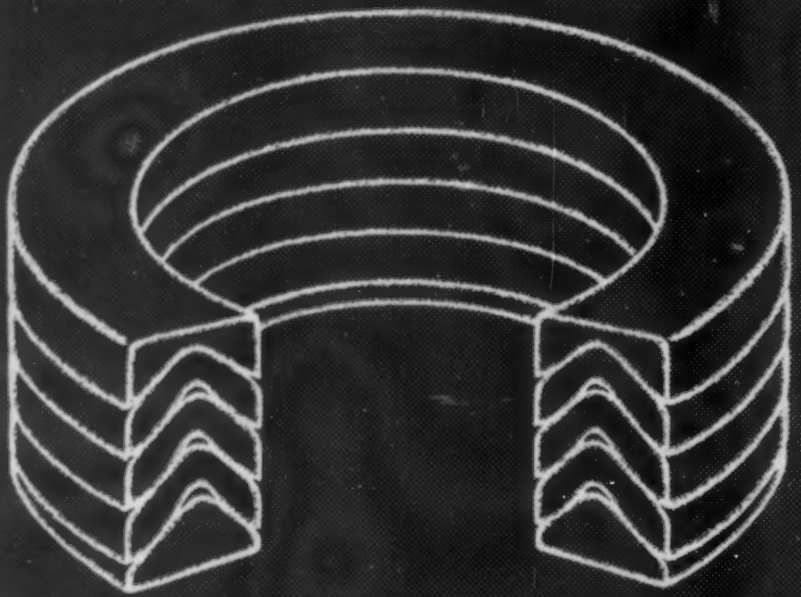
Even under heaviest shock pressures, the valve takes only a split-second to act. In fact, tests prove it takes no longer to act than the duration of an uncontrolled shock impulse.

Denison **Surge Damping Valves** are made in both industrial and aircraft types, for pressures to 5000 psi. They require no adjustments of any kind, need no maintenance, have no moving seals, adjust automatically to any working pressure in any type of circuit, and do not interfere with other circuit functions. An integral check device provides free reverse flow.

The highly compact and efficient Surge Damping Valve (the largest is shown above, one-half actual size) is typical of the complete line of Denison's oil-hydraulic components for circuit pressures to 5000 psi. Wherever the advantages of oil hydraulic equipment can be applied, you can be sure of best results, longest service, and less maintenance when you insist on Denison HydrOILic Equipment. Let us give you full information on hydraulic equipment for any need. Request Bulletin 146; there's no obligation.

The DENISON Engineering Company, 1166 Dublin Road, Columbus 16, Ohio

The MOST COPIED packing on the market . . .



R/M VEE-FLEX®

The surface of each R/M Vee-Flex Ring is convexly curved where it touches the next ring. When the hydraulic pressure stroke occurs, this construction produces an automatic seal laterally against the stuffing box wall and longitudinally against the next ring. This fact has been proved by photoelastic analyses and corroborated by radial pressure tests at the Franklin Institute Laboratories for Research and Development.

R/M Vee-Flex is a self-sealing, self-adjusting packing that requires only finger-tight gland adjustment and that seals even when equipment is not in motion. This packing is exceptionally pressure-resistant — five different types will seal, without extruding, under pressures in excess of 6000 psi. For packing pumps, valves, rams, presses, cylinders, accumulators or other hydraulic equipment it has no equal. Different types are available for air, gas, steam, oil, water, food products, etc. Write for R/M Vee-Flex Bulletin giving complete data and table of sizes.

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

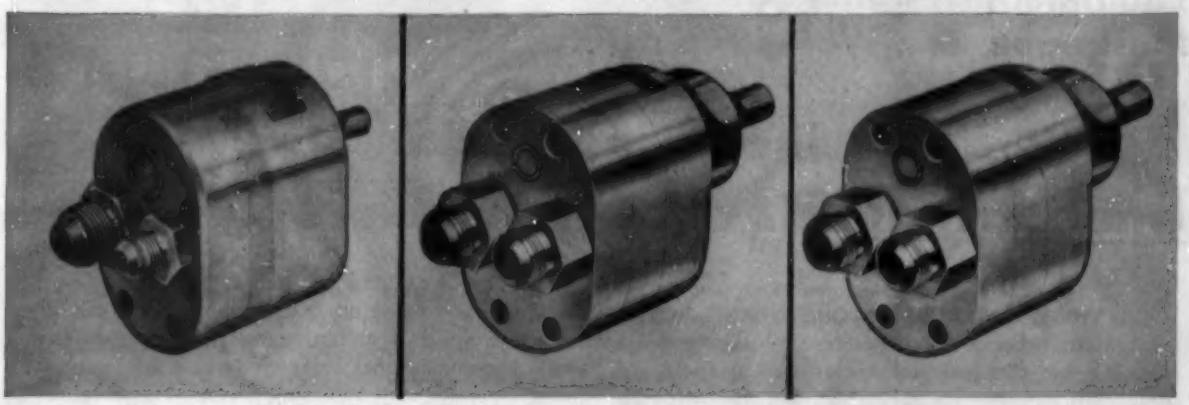
specify with confidence...

HYDRAULIC PUMPS
FLUID MOTORS

Design engineers have confidence when they specify dependable Eastern Hydraulic Pumps and Fluid Motors. Exclusive Eastern features create an economical, reliable, and compact unit for the heart of your hydraulic mechanism.

Lightweight construction of aluminum alloy housing, nitralloy gears and shaft, and close tolerances assure longer service, higher volumetric efficiency, and more dependable operation. Various types of mountings are available for space saving installation.

In many cases by specifying an Eastern unit you realize dollar savings as well as great savings in size. They cut operating costs by keeping space requirements and weight to a minimum.



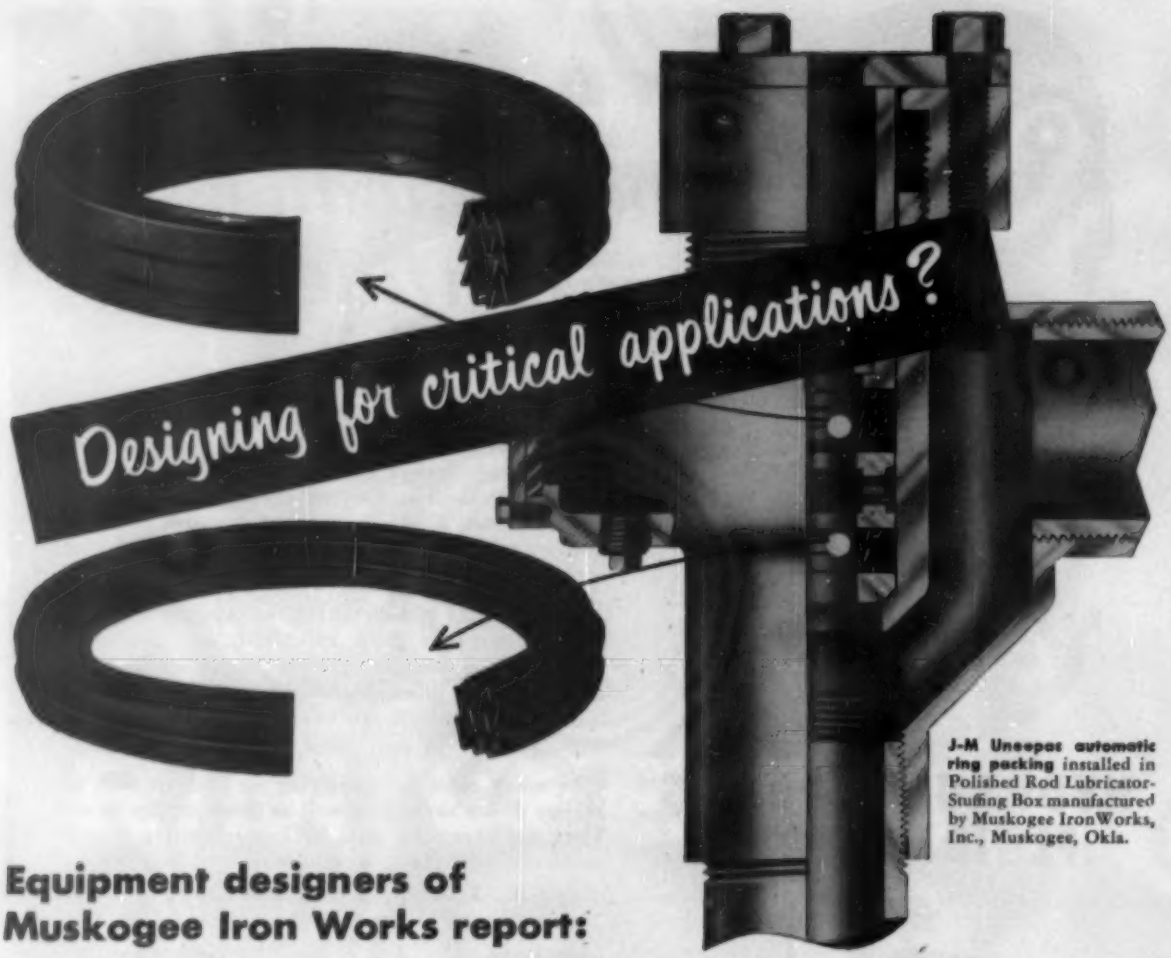
100 Series — Heavy duty gear pump. Delivery from .1 to 5 gpm and working pressures up to 1,500

700 Series — High pressure gear pump. Delivery from .6 to 9.6 gpm and pressures up to 1,500 psi.

2700 Series — Gear type fluid motor. Torque output — 0 to 15 ft. pounds.

Send for Eastern Hydraulic Catalog F-800. Contains valuable engineering diagrams and information.

Eastern INDUSTRIES, INC.
296 ELM ST., NEW HAVEN, CONN.



J-M Uneepac automatic ring packing installed in Polished Rod Lubricator-Stuffing Box manufactured by Muskogee IronWorks, Inc., Muskogee, Okla.

Equipment designers of Muskogee Iron Works report:

"Greatly increased packing life . . . Uneepac guards against pressure damage"

FOR THEIR NEW LUBRICATOR-STUFFING BOXES, design engineers of Muskogee Iron Works needed a packing with long service life as well as foolproof operation. Uneepac, the Johns-Manville automatic ring packing, fully met both of these requirements and contributed to the success and acceptance which the equipment has encountered.

In this application, Uneepac protects itself against damage by excessive gland pressure. The lips of each ring are guarded by the projecting portion of the Uneepac Center section. As a result, far greater service life and reliability is obtainable in this application than with other types of packings.

Uneepac offers many other important advantages for use in pump rods and plungers, compressors and similar equipment. Seals effectively in a minimum of space. Operates with minimum friction. Has excellent pressure sensitivity. Uneepac provides trouble-free operation because each ring positions itself diametrically as well as vertically. Header or follower rings are not always required because each Uneepac ring is a complete, self-protected unit.

To learn how Uneepac may aid your new equipment design, too, write for booklet PK-58A. Just address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

JM

Johns-Manville PACKINGS & GASKETS

It Takes MORE than a Collection of Parts

To Make A VICKERS CUSTOM BUILT POWER UNIT

Improve and Simplify Hydraulic Design

Reduce Installation and Maintenance Costs

A Vickers Custom Built Power Unit is much more than a collection of parts . . . just as the machines you build are more than the castings, shafting, gears, motors, etc. that go into them.

The Vickers Unit is designed and built with the "know-how" obtained during more than a quarter century of experience in practically every kind of hydraulic operation, plus a thorough understanding of your needs. It is built exactly to your individual requirements. All necessary pumps, valves, intermediate piping, oil reservoir, motors, controls, etc., are in one compact and self-contained "package". It includes all needed hydraulic accessories such as oil filters, air cleaners, oil level gauges, fittings, etc. Hydraulic connections may be grouped in a conveniently located manifold.

The result is simplification of hydraulic design and important savings in installation and maintenance costs. Vickers undivided responsibility for the entire hydraulic control system is another important advantage to both the machine builder and his customer. • Write for new Bulletin 52-45.

VICKERS Incorporated

DIVISION OF THE SPERRY CORPORATION

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Mullins U.S.A. licenses German firm to use the revolutionary new Mullins Steel Koldflo* Extrusion Process

TODAY—there's a *new way* to make precision cylinders and countless other metal parts. A new process that speeds production—cuts manufacturing costs—and will improve the products *you* make!

Squeezing cold steel into industrial products, long a dream of the metalworking industry, is now a reality!

It's another *first* for Mullins. Another triumph for American engineering skill. It's the truly sensational new MULLINS STEEL *Koldflo* process that literally makes cold steel perform miracles!

Mullins, maker of auto parts and kitchen equipment, has developed *Koldflo—the first workable and practical* process for the mass production of precision metal parts, with glass-smooth surfaces and exacting tolerances.

Already *Koldflo* is outmoding old-fashioned methods with their costly, time-consuming machining, heat treating, grinding and honing operations.

Koldflo turns out one perfect glass-smooth cylinder after another with almost unbelievably exact tolerances!

That's why Kabel und Metallwerke, Neumeyer of Nurnburg, one of the first companies in the world to successfully cold extrude steel, wanted the license to use the *Koldflo* process. That's why they stated: *"This new Mullins process is entirely novel and more advanced than any other we have studied."*

Now, with expanded facilities, supported by Mullins' engineering and development departments—we offer industry complete parts manufacturing facilities using the proved *Koldflo* process.

Write for complete information and descriptive literature. We will gladly demonstrate what *Koldflo* can do for you. Write to Dept. AH-1

Koldflo **DIVISION**

**Koldflo is a Trade Mark of the Mullins Manufacturing Corp.*

MULLINS MANUFACTURING CORPORATION

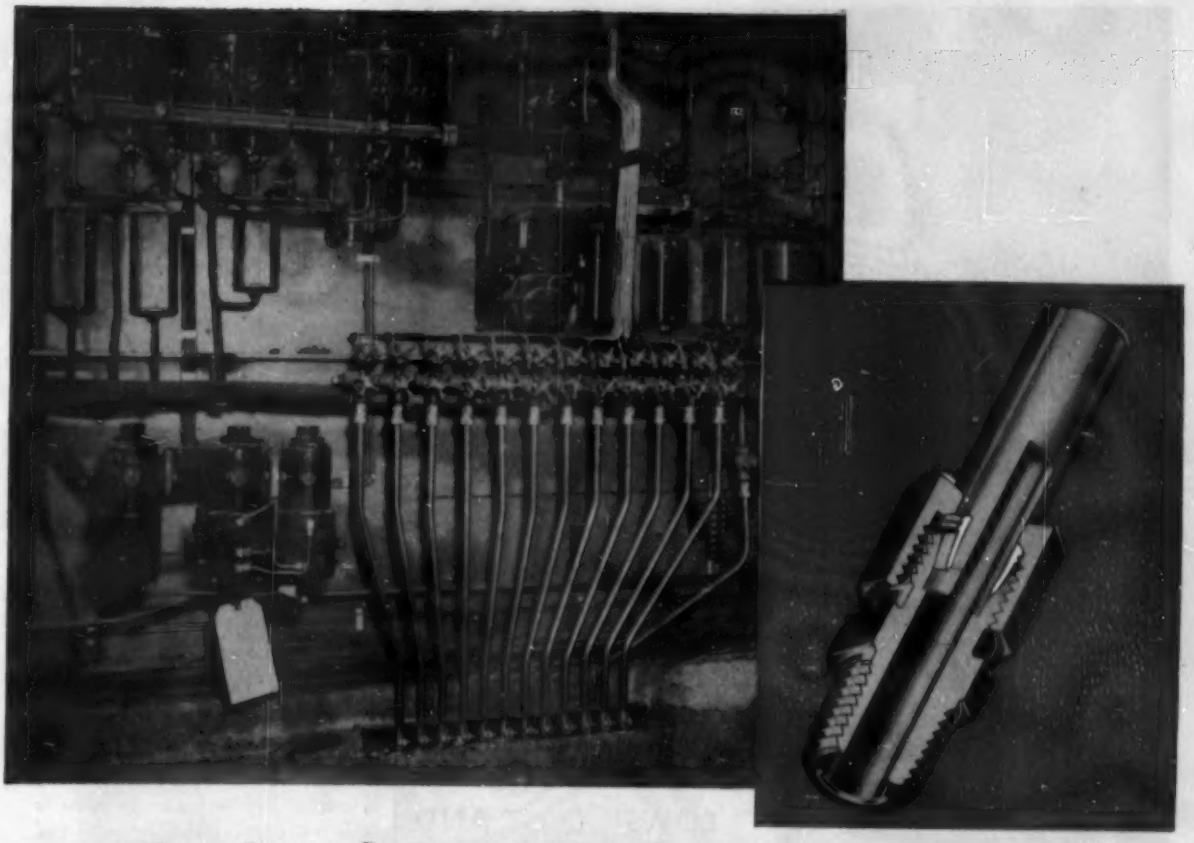
Salem, Ohio

Accumulator and booster shells for presses

S. A. E.-clevis and power steering cylinders

Accumulators for hydraulic power systems

Lift truck stud-type tilt cylinder shells



Weatherhead ERMETO® Connectors
solve four problems of circuit design

1. **LESS PRESSURE DROP**—Tubing, used with Ermeto Fittings, reduces turbulence caused by sharp angles and numerous joints common to pipe installations by allowing smooth, wide-radius bends with fewer connections.
2. **FASTER INSTALLATION**—Ermeto requires no flaring, no threading, no welding, no soldering. You get positive, leakproof seals in 30 seconds and a wrench is the only tool you need.
3. **FASTER SERVICING**—Ermeto joints can be disconnected and reconnected in a matter of minutes. Reassembled, they continue to provide pressure-tight connections.
4. **LOWER COST**—Fewer connections and less tubing footage cut the cost for materials. Ermeto durability holds replacement inventory to a minimum.

GET THE DETAILS NOW!

See your Weatherhead distributor or get Catalog E-1457 by writing: The Weatherhead Company, Department A, 300 East 131st Street, Cleveland 8, Ohio.

Circle 133 on Reader Service Card

IN AIR AND HYDRAULIC CYLINDERS DARCOVA PUMCUPS PERFORM MORE EFFICIENTLY AT LOWER COST AND LAST LONGER!

Precision-built and texture-engineered for practically all services, Darcova Pumcups outlast most other packings at least 3 to 1. Fluid slippage is virtually eliminated, assuring *continuous* high efficiency. Far less maintenance! Lower operating costs! Send today for a free bulletin packed with helpful data and proof.

DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 15, PA.

PUMCUPS

LETTERS to the Editor

Fluid Power Circuits

I wish to compliment you on the thirty-two page section in the January APPLIED HYDRAULICS on "Fluid Power Circuits". I feel that this material would have value if placed in the hands of my hydraulic classes for machine repair apprentices. Are reprints available, and if so, on what basis?

H. M. Barnes,
Instructor, Technical Training Section,
Chrysler Corporation
Detroit, Mich.

Thank you Mr. Barnes. We appreciate your comments. Reprints of "Fluid Power Circuits" are available. Single copies are $.50; in lots of 50 to 100 copies the price is $.40; in lots of 100 or more the price is $.35 per copy. We hope you find this material helpful in your classes.

I have just received the January issue of APPLIED HYDRAULICS and was very favorably impressed by the very excellent article entitled "Fluid Power Circuits" by Mr. Paul Rolnick. I would like to know the possibility of obtaining about 100 reprints for inclusion in our Machine Development Standards.

Edgar H. Schmidt,
Development Project Engineer,
Mechanical Development Lab.,
E. I. du Pont de Nemours & Co.
Wilmington, Delaware

To take care of such requests as your own, we have published a moderate supply of reprints of "Fluid Power Circuits". The price is quoted in another letter in this column. We particularly appreciate the use you propose for this reprint.

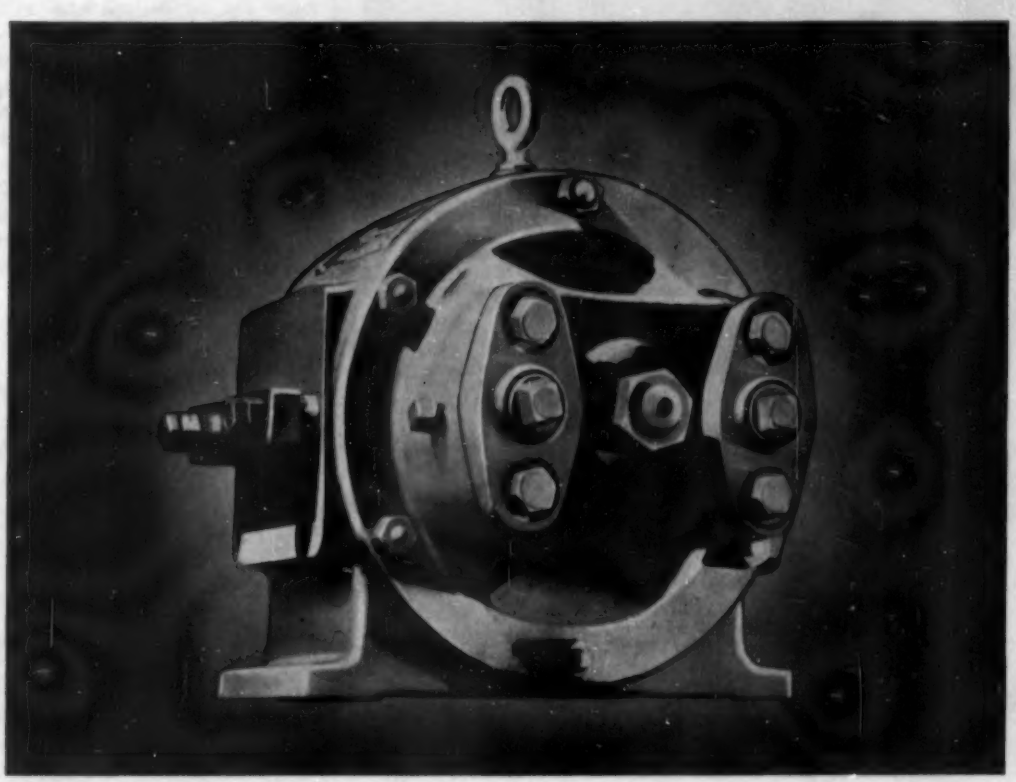
In reviewing your "Fluid Power Circuits" in the January, 1954 issue of APPLIED HYDRAULICS, we found a few omissions that we believe might be a bit confusing. On page 23, diagram No. 5, we be-

Continued on page 36

FOR VARIABLE PRESSURES TO 3000 P.S.I.

HELE-SHAW PUMP

Famous for ease of application... smoother power... flexibility



HELE-SHAW PUMP generates fluid power (oil under pressure) to operate rams, plungers, etc. Suitable controls are available so the unit can be applied to any type of oil-hydraulic-actuated reciprocating machine or to hydraulic motors for rotary applications. Pump is self-lubricating; driven by a constant-speed prime mover; subject to precise control; can be reversed instantly or gradually.

Hele-Shaw Pumps are made in a wide range of capacities and pressures. Send coupon for descriptive bulletin... and call on AE engineers and representatives to help you investigate possible applications.

WHEN IT'S HIGH PRESSURE, IT'S AMERICAN!

AMERICAN ENGINEERING
COMPANY
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In Canada: Affiliated Engineering Corporations, Ltd., Montreal 2, P. Q.

AE Products are: Taylor and Perfect Spread Stokers. Marine Deck Auxiliaries, Hele-Shaw and Hydromite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2530 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: Kindly send me complete information about the Hele-Shaw Pump.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

Chem-o-green Back-up Rings—made of duPont chemically impervious TEFLON—answer the "O" Ring extrusion problem. Three types—solid rings, split rings and the popular spiral rings for quick, easy installation.

- Eliminate chemical inspection.
- Zero swelling in hydrocarbons and newer synthetic fluids.
- Service temperature range from minus 110°F to 500°F.
- Waterproof, non-flammable.
- Requires no water-soak for installation.
- Unsurpassed anti-friction properties.

Chemiseal "O" Rings—a complete line of homogeneous synthetic rubber packings made in both AN and commercial compounds.

Both a "packing package", made in all standard sizes for "O" Ring gasket, packing and universal tube fitting services.

Take advantage of one source and one responsibility for this important "packing package". Write for Bulletin OB-1152.

UNITED STATES GASKET COMPANY
CAMDEN 1 • NEW JERSEY
FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS
Representatives in Principal Cities Throughout the World

Letters to the Editor

Continued

lieve you have forgotten the resistance which should be in series with CR2 because when CR3 picks up, there will be a short between the two lines when CR3 contact shorts out CR2 coil. Then on page 25, in the diagram at the top of the page, there are no designations on the pushbutton elements. The artist was a little careless on some of the electrical diagrams in the manner of his showing "start" or normal open push button elements, they look like normally closed elements. However, would you please send us a copy of the reprint for our files. We have found them very interesting and will no doubt be very helpful in our future designs.

JULES GILPATRICK,
Electrical Engineer,
Rway Consulting Engineers
Sheboygan, Wisc.

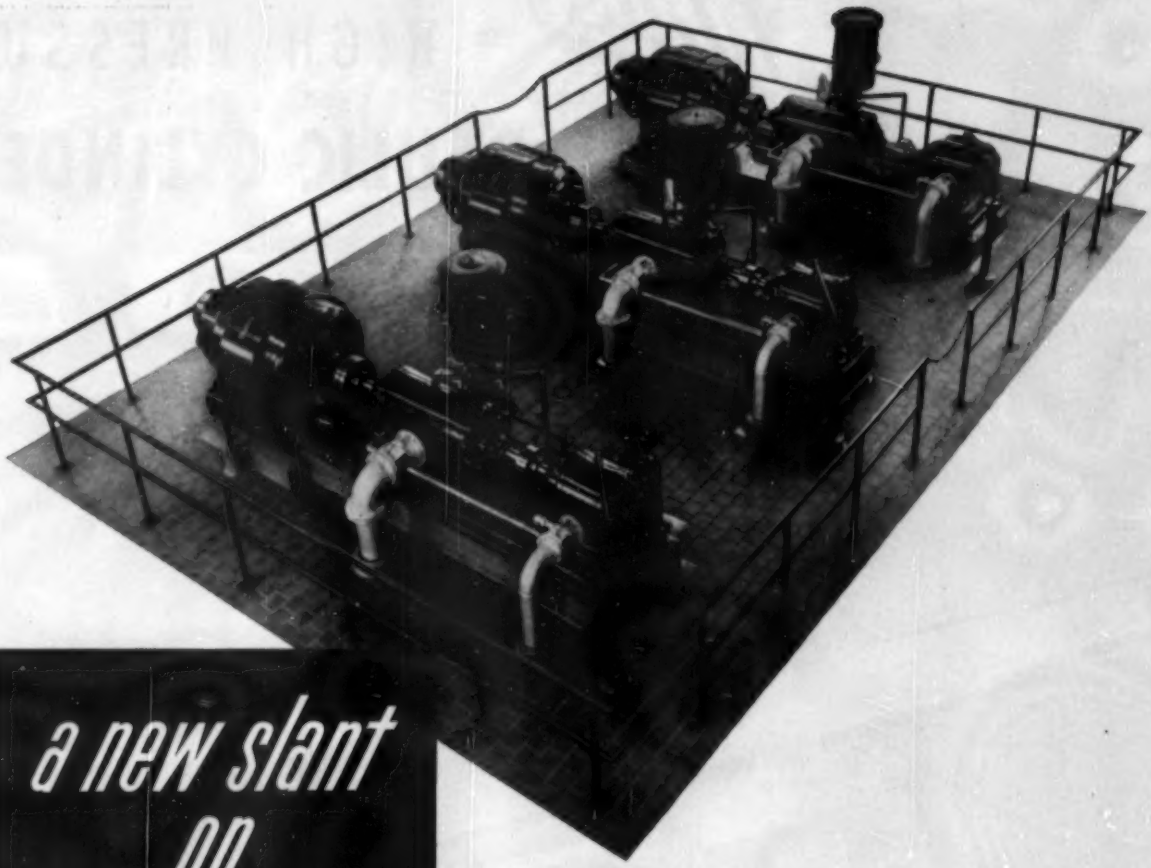
You are quite right, Mr. Gilpatrick; a resistance should be shown in circuit 5 on page 23. We show this resistance in circuit 4, it should appear similarly in 5. The designation or legend for the push buttons should have been added. Since the same symbols, with legend, are in another circuit on the same page, we believe that the reader will find the drawing clear. In the descriptions of the various circuits it is clear in nearly all cases whether starting elements are normally open or normally closed.

I have just received my January 1954 copy of APPLIED HYDRAULICS and am extremely pleased with the section on "Fluid Power Circuits." This section has been beautifully prepared. Because of the concise form in which it is presented, I would very much appreciate your sending me a half dozen copies of this section. These would be for distribution to the various project engineers in our Mechanical Engineering Department.

R. A. BROWN,
Chief Mechanical Engineer,
Consolidated Western Steel
Div. U.S. Steel Corp.
Los Angeles, Calif.

The six copies have been forwarded to you. This section has

Continued on page 40



a new slant on compressors

***simple *compact *direct drive**
***valveless *vibrationless *pulseless**

If you've never considered the advantages of Fuller Rotary Compressors and Vacuum Pumps, now is the time to do so.

Fuller Rotaries have many unique and beneficial advantages for you. For instance, they can be placed almost anywhere out of the way, because their vibrationless, rotary action permits, for example, balcony installation. Because they operate by direct drive, you eliminate the initial and maintenance costs, as well as transmission losses incident to gear and belt drives. Maintenance costs are kept to a minimum.

Because Fuller Rotaries compress without reciprocating pistons, you get a non-pulsating air stream. They are extremely compact for the volume delivered; sizes to deliver up to 3300 cfm. free air, for pressures from atmosphere to 125 psig. Write today to the Fuller Company, Catasauqua, Pa. for literature and engineering data.

Fuller

FULLER COMPANY
Catasauqua, Pa.

Pioneers of high efficiency vane-type rotary compressors

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C-230
1862

Miller

HIGH PRESSURE HYDRAULIC CYLINDERS

HARD CHROME PLATED PISTON RODS
Prevent Scratch-Damage, Nicks and Rust

SOLID STEEL HEADS, CAPS and MOUNTINGS
Eliminate Breakage

DIRT WIPER SEALS
Protect Rods, Seals, Bushings

Standard Leather Cup Seal Assembly Shown Is Interchangeable With Miller Standard Piston Ring Piston Assembly

WRITE FOR CYLINDER BULLETINS H-104 and A-105

Complete Miller cylinder line includes: air cylinders, 1½" to 20" bores, 200 PSI operation; low pressure hydraulic cylinders, 1½" to 6" bores for 500 PSI operation, 8" to 14" bores for 250 PSI; high pressure hydraulic cylinders, 1½" to 12" bores, 2000-3000 PSI operation. All mounting styles available.

MET J. I. C. HYDRAULIC STANDARDS years before their adoption in 1949.

SPACE-SAVING SQUARE DESIGN originated by Miller in 1945.

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Any of the interchangeable mountings illustrated can be easily attached to Basic Model 53 by tie rod nuts in a few moments by any customer. This gives you a wide selection of models for original equipment and for convenient re-use with other mounting attachments to simplify your "stock" and maintenance problems.

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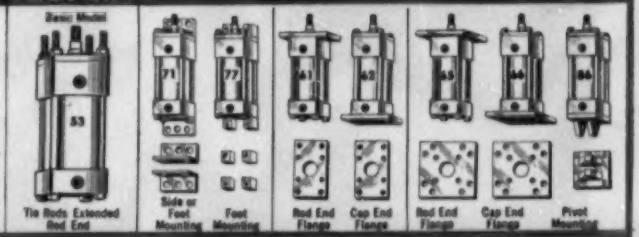
"Stock" Cylinders are shipped as Basic Model 53. Your selection of Mounting Attachments are shipped (unattached) with cylinders. Prices are F.O.B. [illegible]



Bore	Stroke	Cushion	BASIC CYLINDER PRICES ONLY: AIR A53	BASIC CYLINDER PRICES ONLY: HYD. H53	PRICES OF MOUNTING-ATTACHMENTS ONLY: AIR A77	PRICES OF MOUNTING-ATTACHMENTS ONLY: HYD. H77	PRICES OF MOUNTING-ATTACHMENTS ONLY: AIR A61	PRICES OF MOUNTING-ATTACHMENTS ONLY: HYD. H61	PRICES OF MOUNTING-ATTACHMENTS ONLY: AIR A65	PRICES OF MOUNTING-ATTACHMENTS ONLY: HYD. H65
1½"	2"	Non		$58.50		$2.90		$8.20		$14.35
1½"	4"	Non		60.70		2.90		8.20		14.35
1½"	6"	Non		62.90		2.90		8.20		14.35
1½"	8"	Non		65.10		2.90		8.20		14.35
1½"	11"	Non		68.40		2.90		8.20		14.35
2"	2"	Non	$37.70		$2.05		$4.60		$6.90	
2"	4"	Non	39.40		2.05		4.60		6.90	
2"	6"	Non	41.10		2.05		4.60		6.90	
2"	8"	Non	42.80		2.05		4.60		6.90	
2"	11"	Non	45.35		2.05		4.60		6.90	
2"	3"	Both	62.05	94.50	2.05	2.95	4.60	8.55	6.90	17.05
2"	5"	Both	63.75	97.00	2.05	2.95	4.60	8.55	6.90	17.05
2"	7"	Both	65.45	99.50	2.05	2.95	4.60	8.55	6.90	17.05
2"	9"	Both	67.15	102.00	2.05	2.95	4.60	8.55	6.90	17.05
2"	13"	Both	70.55	107.00	2.05	2.95	4.60	8.55	6.90	17.05
2½"	2"	Non	41.45	73.30	2.25	2.95	4.80	9.00	7.55	19.80
2½"	4"	Non	43.35	76.00	2.25	2.95	4.80	9.00	7.55	19.80
2½"	6"	Non	45.25	78.70	2.25	2.95	4.80	9.00	7.55	19.80
2½"	8"	Non	47.15	81.40	2.25	2.95	4.80	9.00	7.55	19.80
2½"	11"	Non	50.00	85.45	2.25	2.95	4.80	9.00	7.55	19.80
3¼"	3"	Both	77.80	126.85	2.55	4.35	6.35	11.75	9.90	23.10
3¼"	5"	Both	79.80	129.85	2.55	4.35	6.35	11.75	9.90	23.10
3¼"	7"	Both	81.80	132.85	2.55	4.35	6.35	11.75	9.90	23.10
3¼"	9"	Both	83.80	135.85	2.55	4.35	6.35	11.75	9.90	23.10
3¼"	13"	Both	87.80	141.85	2.55	4.35	6.35	11.75	9.90	23.10
4"	2"	Non	56.25	106.00	2.85	5.15	6.70	12.90	11.05	26.80
4"	4"	Non	58.85	109.40	2.85	5.15	6.70	12.90	11.05	26.80
4"	6"	Non	61.45	112.80	2.85	5.15	6.70	12.90	11.05	26.80
4"	8"	Non	64.05	116.20	2.85	5.15	6.70	12.90	11.05	26.80
4"	11"	Non	67.95	121.30	2.85	5.15	6.70	12.90	11.05	26.80
5"	3"	Both	98.25		3.15		7.00		12.35	
5"	5"	Both	101.65		3.15		7.00		12.35	
5"	7"	Both	105.05		3.15		7.00		12.35	
5"	9"	Both	108.45		3.15		7.00		12.35	
5"	13"	Both	115.25		3.15		7.00		12.35	
6"	2"	Non	80.60		3.35		7.25		13.55	
6"	4"	Non	84.90		3.35		7.25		13.55	
6"	6"	Non	89.20		3.35		7.25		13.55	
6"	8"	Non	93.50		3.35		7.25		13.55	
6"	11"	Non	99.95		3.35		7.25		13.55	
8"	3"	Both	157.35		3.70		10.55		17.60	
8"	5"	Both	162.45		3.70		10.55		17.60	
8"	7"	Both	167.55		3.70		10.55		17.60	
8"	9"	Both	172.65		3.70		10.55		17.60	
8"	13"	Both	182.85		3.70		10.55		17.60	

Miller "Stock" Cylinders fully meet the J.I.C. Standards and are identical to Miller "Custom-Built" Cylinders in design and construction.

"Stock" Air Cylinders are for 200 psi operation, "stock" hydraulic cylinders for 2000-3000 psi operation. Piston Rods of "Stock" Cylinders are "Style No. 2 Standard."

For complete descriptive and dimensional data on both "Stock" and "Custom-Built" Miller Cylinders, write for Bulletins A-105 and H-104 sent FREE on request.

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Complete Miller "custom-built" line includes: air cylinders, 1½" to 20" bores, 200 psi operation; low pressure hydraulic cylinders, 1½" to 6" bores for 500 psi operation, 8" to 14" bores for 250 psi operation; high pressure hydraulic cylinders, 1½" to 12" bores, 2000-3000 psi operation. All mounting styles available. Also, a complete line of Fluid Pressure Boosters and Accumulators.

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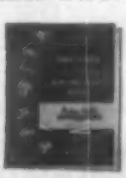
Anker-Holth has the answer!

• Your problem in power motion may be far removed from the Anker-Holth Cylinders shown above. Whatever your need for air or hydraulic cylinder power, Anker-Holth has the engineering know-how and manufacturing facilities to match your specific requirement. Anker-Holth engineers will gladly assist you. Call or write Anker-Holth Division of The Wellman Engineering Company, Dept. C-9, 2723 Conner Street, Port Huron, Michigan.



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ENGINEERED CYLINDER POWER

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Division of THE WELLMAN ENGINEERING COMPANY

Letters to the Editor

Continued

been reprinted, as noted elsewhere in this column. Thank you for your nice letter.

Surge Tank Dimensions

I would be interested in obtaining the calculations for the article "Pneumatic Counterbalancing of Mechanical Presses", published in your December, 1953 issue, as I am unable to arrive at an answer in agreement with the author as regards surge tank dimensions.

N. S. MAY,
Plant Engineering Unit,
Canadian General
Electric Co. Ltd.
Peterborough, Ontario

Thank you, Mr. May for calling this to our attention. There is an error in the article. The installation described in the article is an actual installation. However, the pressure differential works out to 5 psi rather than 2 psi as stated in the article. The calculation based on Boyle's Law is:

Cylinder bore 6 in.; area = 28.27 sq. in.
Piston rod dia. 2 in.; area = 3.14 sq. in.
Working area is = 25.13 sq. in.
Working stroke = 6 in.

Displaced Volume 2 cylinders:
2 x 25.13 x 6 = 300 cu. in. (Approx.)
Hose lines between tank and cylinders
1 in. dia. x 8 ft., volume = 75 cu. in.
Using 10 x 30 in. tank volume = 2350

$P_1V_1 = P_2V_2$
Where: $P_1 = 40$ psi
$V_1 = 2350 + 75 + 300 = 2725$ cu. in.
$V_2 = 2350 + 75 = 2425$ cu. in.

$40 \times 2725 = P_2\ 2425$
$P_2 = 45$ psi

"Servomechanisms for Industry"

Would you please send a reprint of the articles titled "Servomechanisms for Industry" by F. B. MacLaren which commenced in the September 1953 issue?

P. A. TAYLOR,
Mechanical Engineering Dept.,
National Institute of Agricultural Engineering,
Wrest Park, Silsoe, England

The three articles (September, October and November issues) have been reprinted as a unit. A copy has been sent to you. (EDITOR'S

Continued on page 42

In Gerotor hydraulic pumps . . .

and motors . . .

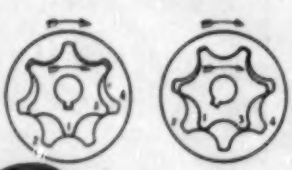
the GEROTOR*

makes the difference!

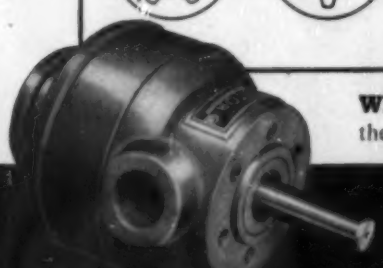
The patented Gerotor principle is represented by a pair of gear-shaped elements, one within the other. In pumps, power is applied through the shaft to the inner Gerotor and is transmitted in the closed mesh region to the outer Gerotor; in motors, the same principle operates in reverse.

Each tooth of the inner Gerotor is in sliding contact with the outer Gerotor at all times, providing continuous fluid-tight engagement at very low contact speed. The contact points revolve only once in seven to nine revolutions, depending on the type of unit. This reduced friction permits higher shaft speeds, assures longer life. Opening and closing of chambers between the teeth is gradual across long ports, eliminating sudden shock and excessive turbulence, and reducing pressure variations found in conventional gear pumps. In Gerotor hydraulic pumps and motors, the Gerotor principle produces high volumetric and mechanical efficiency.

**Gerotor is not just a name . . . it's the heart of the finest hydraulic pumps and motors made.*



The two Gerotors revolve at different speeds, resulting in a continuous opening and closing of spaces as shown in this diagram. Follow the changing position of tooth #1 as rotation takes place. Note its relation to space #2. As rotation continues, tooth #1 gradually displaces oil from space #2, thus creating pressure.



Whatever your need in hydraulic pumps or motors, consult the Gerotor May engineers. *Write for free literature.*

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HYDRAULIC PUMPS & MOTORS

Pack more performance into your hydraulic systems

for **PUMPS, VALVES, PRESSES, CYLINDERS...**

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"John Crane" Chemlon "C-V" Ring special cross sectional design affords effective sealing at practically finger-tight gland pressure.

To bring you all the important advantages of Teflon for your hydraulic sealing applications, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.

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*"DuPont's trademark for tetrafluoroethylene resin

JOHN CRANE CRANE PACKING COMPANY

Letters to the Editor

Continued

NOTE: Readers may secure copies by addressing their requests to Servomechanisms, Inc., Westbury, L.I., N. Y.

Reprints Now Available

I would like to have a check list of the available reprints on hydraulic subjects based on material from the magazine APPLIED HYDRAULICS.

JOHN J. CONWAY, JR.
Baldwin, N. Y.

Copies of the following reprints from APPLIED HYDRAULICS are available at the present time: "Which Design Uses Hydraulic Gear, Chain and Belt Drives" (March, 1953): "Application of Shear Type Sleeve Fittings" (March, 1953); "Accumulator System Provides Overload Protection on Stone Crusher" (December, 1952); "High Oil Pressures Widen Applications in New Mill Design" (May, 1953); "How a Die Caster Met His Fluid Cost Problems" (September, 1952); and the series of three articles, "Servomechanisms for Industry" which appeared in the September, October and November, 1953 issues.

Design of Hydraulic Piping Systems

Is there any published information on the design and installation of hydraulic piping systems that would be helpful to the small manufacturer with limited experience in this field. We are looking for information on selection and installation of materials rather than sizing of pipe.

J. W. NELSON,
Engineer,
Bemis Manufacturing Co.
Sheboygan Falls, Wis.

As far as we know there is no published material, other than manufacturers' data sheets, that would cover exactly what we believe you would require. The reason is that, while sound principles can be laid down, the design of individual systems including the selection of ma-

Continued on page 44

EVERY ONE OF THESE "PACKAGED" CONTROLLED-AIR-POWER DEVICES HAS ONLY ONE REASON FOR EXISTING—

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THE BELLOWS ROTARY FEED TABLE
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"Dog Leg" piping connections made with Barco Swivel Joints to the hydraulic cylinder of this Kux Die Casting Machine permit quick movement of the press head to any desired position.

BARCO *Swivel Joints*

SAFETY is one significant reason for using Barco Swivel Joints on HYDRAULIC APPLICATIONS. Pressures often run to 3,000 psi, or more. For such service, metal piping and flexible joints offer important advantages. *Non-rigid* type connections can burst instantly without warning, causing injuries to personnel, fire, and waste of valuable oil. *Insurance companies counsel against such hazards.*

In contrast, Barco Swivel Joints are *pressure-safe* and also *fire-safe.* Even if a joint should wear, there is only a slight seeping of fluid —no bursting nor fire hazard. High shock loads can be handled without danger. Barco joints also give more positive hydraulic contol as there is no "mushiness" caused by stretching of hose.

IT'S easy to get the right answer for even your most special hydraulic, steam, or air piping jobs when you use this new engineering catalog No. 265A on BARCO SWIVEL JOINTS. It is complete with pictures and diagrams showing correct application and contains all specification data for improved Barco Swivel Joints:

- Leakproof! Perfect Sealing—Hot or Cold.
- No Binding, Low Torque! Trouble-free!
- Self-Aligning! Simplifies Installation.
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Manufacturing Co.
532D Hough St., Barrington, Illinois
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Letters to the Editor

Continued

terials, is based upon a study of the operating characteristics involved. The first part of Section D of the APPLIED HYDRAULICS Data List give five of the major handbooks and manuals that are available. Two recently published books, "Pipe Resistance for Hydraulic, Lubricating and Fuel Oils and Other Aqueous Liquids" by T. E. Beacham and "Pipe and Tube Bending" by Paul S. Schubert, both reviewed in recent issues of APPLIED HYDRAULICS, may also be useful to you. We suggest you also ask your supplier of piping and tubing for technical data.

High Pressure Water Relief Valve

Can you advise who might supply a solenoid operated water relief valve with good wearing qualities for operating pressures up to 6000 psi.

HENRY MACALUSO,
Clifton, N. J.

A tear sheet of a list of manufacturers of high pressure water valves (page 232, January Directory issue) has been sent you. We suggest you ask your local manufacturers' representatives.

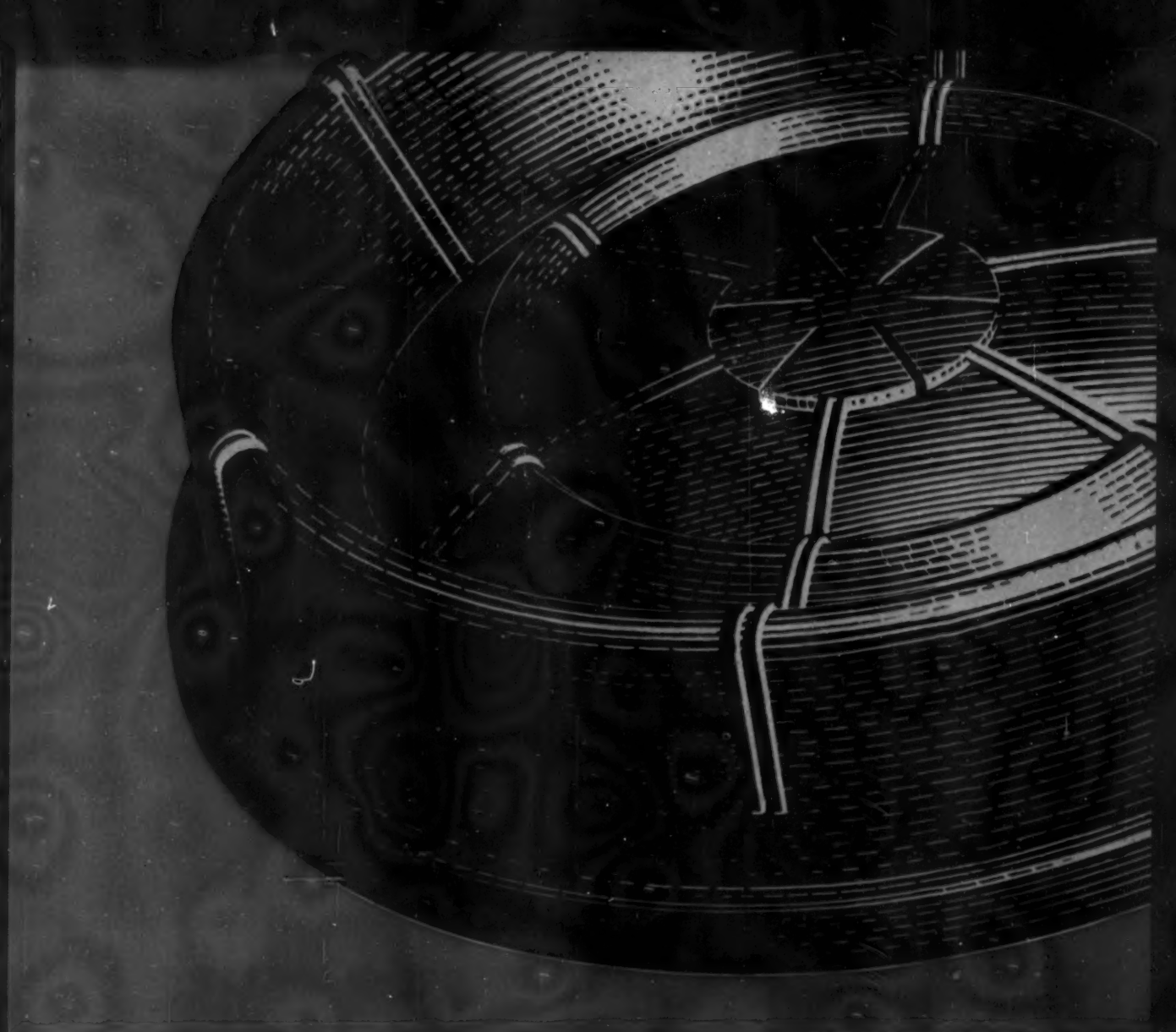
Design Data for Vane Vacuum Pumps

I would appreciate receiving a copy of the Data List mentioned on page 94 of the November issue of APPLIED HYDRAULICS. I am searching for design data for rotary vane vacuum pumps (dry type). If this subject has been covered in APPLIED HYDRAULICS, I would appreciate tear sheets.

JULIUS SOLED,
Ashbury Park, N. J.

Vacuum pumps, except for small, low vacuum service, are outside our field. The literature is very scant. Practically the only publication, a quarterly review "Vacuum" is available from a leading English manufacturer, W. Edwards & Co. (London) Ltd. Worsley Bridge Road,

Continued on page 48



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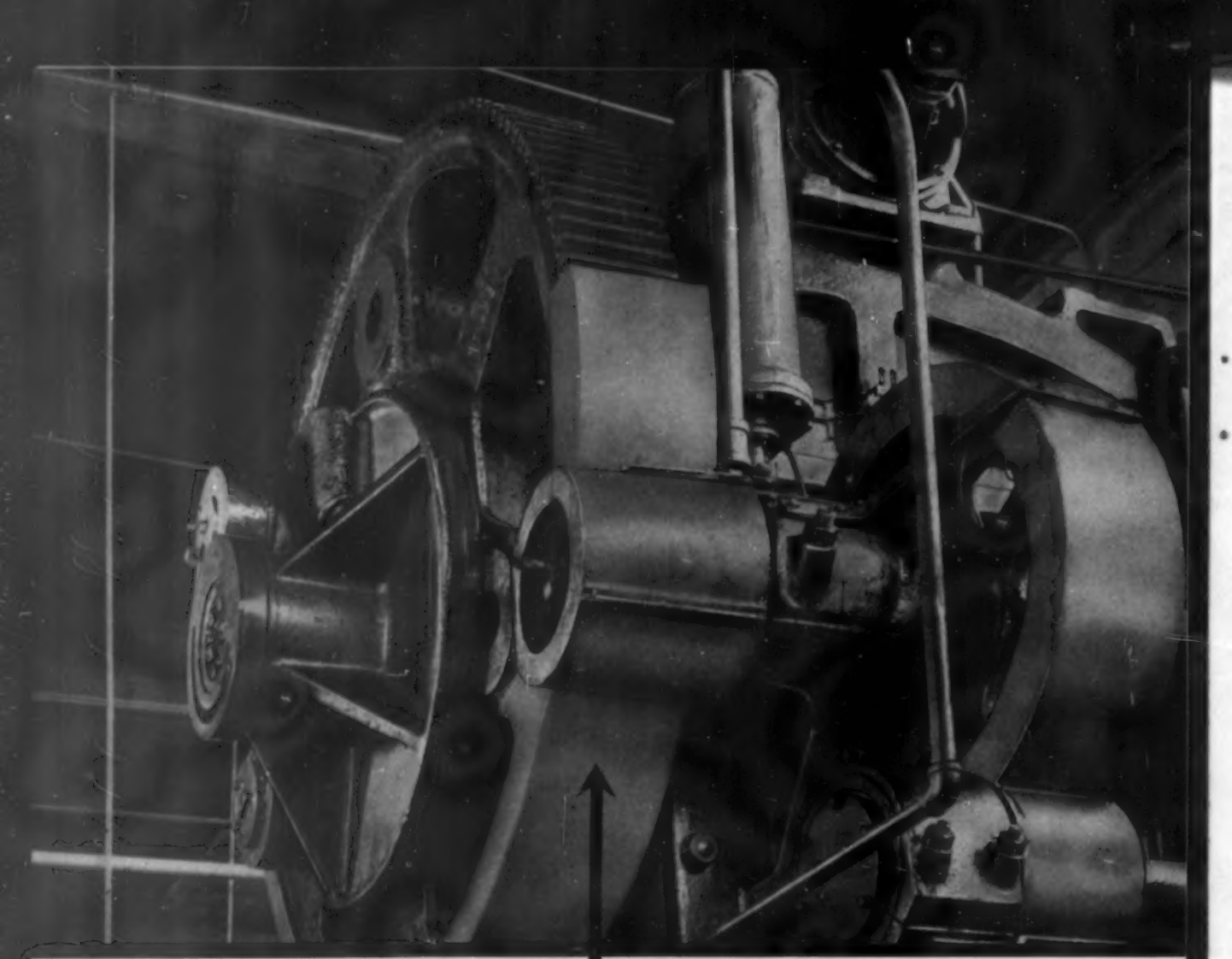

Excessive throw-off stopped with...

Calumet Viscous Lubricants

• The lubrication of exposed gears on a 250 ton press caused trouble for a midwest metal-working company. Lubricant throw-off was excessive, creating unfavorable working conditions; frequent applications of grease interfered with production and raised lubricant consumption. The gear shield in use required pre-heating.

A Standard Oil Lubrication Engineer surveyed the situation three years ago and suggested the use of Calumet Viscous Lubricant 10X, because it is a grease of superior adhesive quality and does not require pre-heating.

Since that time the plant has used Calumet Viscous Lubricant 10X with outstanding results. Run-off to the floors and other parts has been eliminated. Gears are lubricated with maximum efficiency. Most important, lubricant consumption has been cut by more than 20%.

Where open gears as well as some enclosed types are difficult to lubricate, try Calumet Viscous Lubricants. Their superior adhesive quality and greater wetting ability give them high resistance to the washing-action of water and to thinning and throw-off at high temperatures. Several grades of Calumet Viscous Lubricants can be applied by spraying.

Standard Oil Lubrication Engineers are stationed throughout the Midwest. One of these specially trained men is in your area, on the spot when you need him most. To secure his services call your local Standard Oil office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

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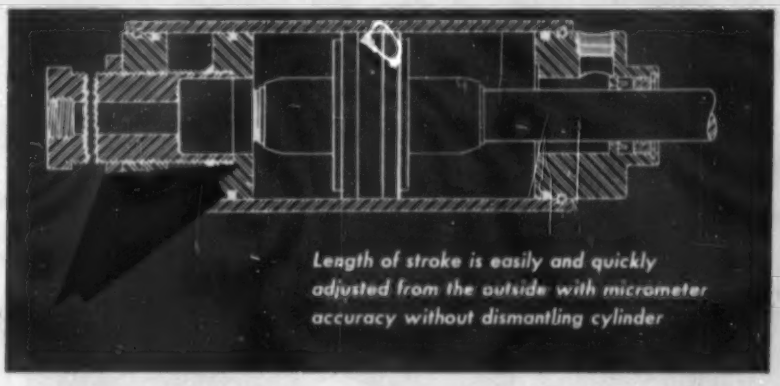
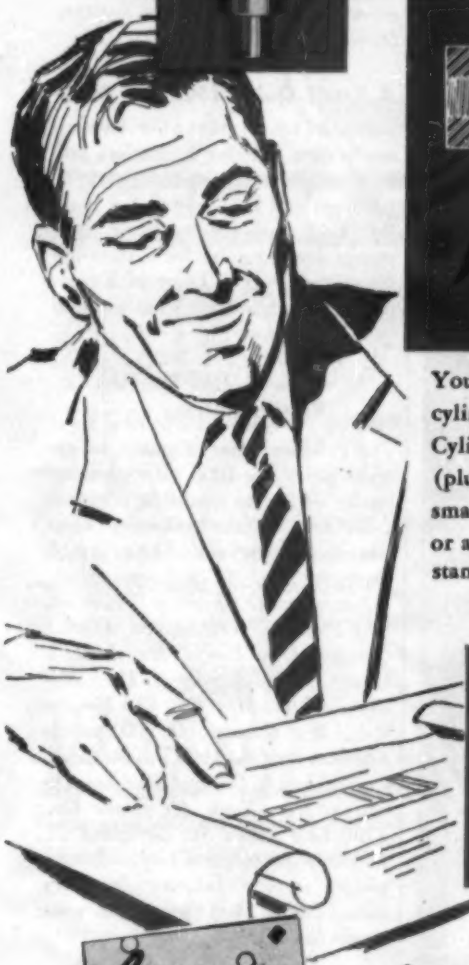
standard O-M cylinders are easily and quickly modified to fit SPECIAL APPLICATIONS



Length of stroke is easily and quickly adjusted from the outside with micrometer accuracy without dismantling cylinder



You don't pay for special patterns . . . and you don't have to use a cylinder that's not quite "right" for the job when you choose the O-M Cylinder. Since nearly all parts are standardized in O-M Cylinders (plus one or two semi-standard parts), the additional cost is extremely small when you need a duplex, triplex, adjustable-stroke, tandem—or any other "special" type cylinder for applications not suited to standard units.

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O-M Cylinders require ⅓ *less installation space* than conventional cylinders of the same bore because O-M's SPECIAL INTERLOCKING MECHANISM does away with projecting tie rods and end caps. Also provides better balance, reduces distortion . . . giving O-M the *lowest coefficient of friction of any cylinder.* End plugs tapped for universal mounting. Any one or combination of mounting brackets may be used to install without disassembling or changing cylinder. Easily removed, inspected, repaired. ALL-STEEL with bearing bronze—no castings.

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- Aeroquip 1503 or 1502 Single Wire Braid Hose and/or MIL-H-5511
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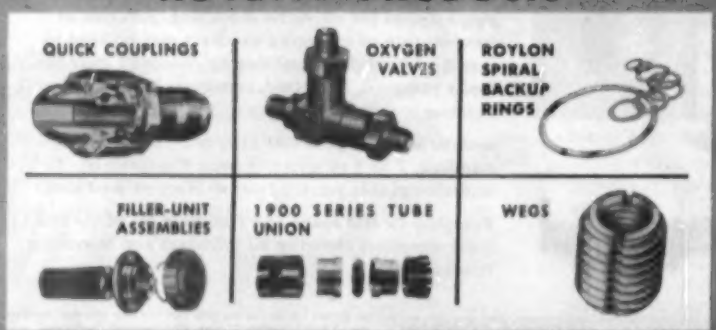

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Letters to the Editor

Continued

Lower Sydenham, London, S.E. 26, England. A rather interesting elementary treatise "Air at Medium Pressure and Vacuum, Equipment and Data" by O. Bogart, engineer at Leiman Brothers, Inc., Trenton, N. J., recently published, is reviewed in this issue. The best source for design data would be the literature of various manufacturers. A list of manufacturers of vacuum pumps is given on page 186 of the January Directory issue.

A Small Quiet 1000 psi Pump

We have an elevator leveling mechanism utilizing hydraulics and have need of a pump to operate at 1000 psi and a capacity of 3 gpm. We find our present vane type pumps are too noisy for certain applications. Do you know of a company who might have what we need in a quiet pump?

LAWRENCE J. RYAN,
Western Mass. Specialty Co.
Pittsfield, Mass.

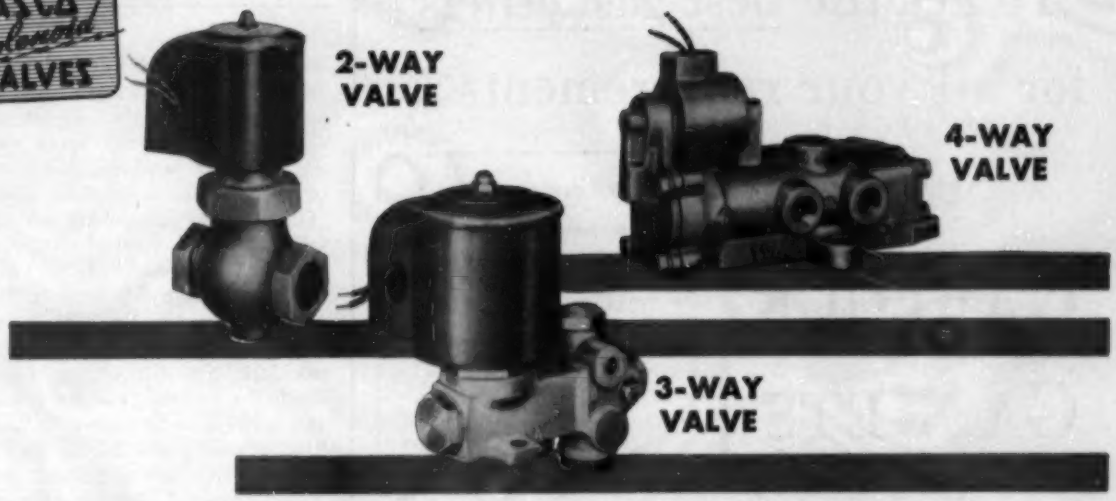
We believe that a pump to operate quietly at 1000 psi with a capacity of 3 gpm could be obtained from any of the following companies: Commercial Shearing & Stamping Co., 1175 Logan Blvd., Youngstown, O.; Eastern Industries, 296 Elm St., New Haven, Conn.; Gerotor May Corp., Maryland & Oliver Sts., Baltimore 3, Md.; Hydraulic Press Mfg. Co., 830 Marion Rd., Mt. Gilead, O.; Denison Engineering Co., 1166 Dublin Road, Columbus 16, O.; and Hydreco Division, New York Air Brake Co., 1100 East 222nd St., Cleveland 17, O. There is a larger list of such companies in our January Directory issue under both gear and vane pump listings.

Another Answer to Groove Design Problem

It is apparent that you did not have our answer on hand to Mr. Doyle's problem (November, 1953 issue of APPLIED HYDRAULICS, page 30) when you published one answer to his question as to whether it might be preferable to use a tubing of larger diameter and

Continued on page 50

ASCO Solenoid VALVES



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Leather	GR-S
Kel-F†	Neoprene
Teflon‡	Silicone
	Thiokol
	Vegetable fibre

There is always *one* type of gasketing material that's best for a particular application. When you call on Garlock, you're sure to get the material you need to meet your specific service requirements. Here's why: Garlock can furnish sheet packing or cut gaskets made from *any* one of the basic gasketing materials. We are *not* limited to a few gasketing specialties.

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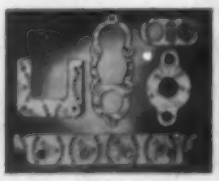
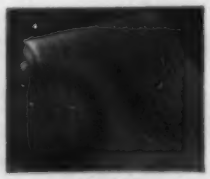
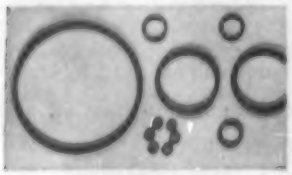


Duck Inserted Rubber Gaskets



Cork-Fibre Sheet



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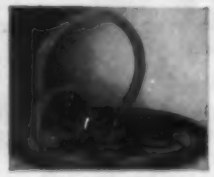

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Letters to the Editor

Continued

stretch the "O" ring (⅓ inch x .0625) or use a leather ring or packing to seal an alcohol base solvent. We do not fully agree with the one reply published. We know of certain other applications where "O" rings are functioning entirely satisfactorily. A copy of our letter to Mr. Doyle is enclosed.

(Excerpt from this letter to Mr. Doyle) Your cylinder inside diameter of .495/.496 inch would seem practical; the difficulty probably lies in the dimensions of the groove you have cut in the piston. To function properly, certain factors of groove design are important and, if we properly interpret your remarks, the groove you have used is too small. However, we hesitate to make any recommendations without more details. If you will send us a simple sketch of the cylinder and piston showing the dimensions you have used, we'll be able to give you a much more definite answer. The handbook enclosed includes tables of cylinder and groove dimensions for use with various standard size "O" rings. Using them, we believe you'll find the pump functioning much easier and to your satisfaction.

L. W. Baker,
Goshen Rubber Co., Inc.
Goshen, Ind.

Small Capacity High Pressure Pump

We are working at the present time on hydraulic drives for our high voltage power circuit breakers, and have been looking for some time for information on small hydraulic pumps. If you could tell us where we could obtain any information on hydraulic pumps that will operate at approximately 3000 psi, with capacity from .3 to 1 gpm, we would appreciate it very much.

M. S. Prentice,
Pacific Oerlikon Co.,
Tacoma, Wash.

Variable volume pumps that are standard items of manufacture would take care of your requirements. A list has been forwarded to you. A more complete list of such manufacturers and suppliers is on page 188 *of the* 1954 *Directory issue of APPLIED HYDRAULICS.*

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CYLINDERS.. Air or Hydraulic

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Bendix Aviation Corporation

Frank L. Mackin
General Motors Institute

D. F. Green
Williams-White & Co.

Outstanding Men Accept as Judges for 1954 PRIZE PAPER CONTEST

WE ARE very happy to announce that three outstanding authorities have accepted our invitation to serve as judges for the 1954 APPLIED HYDRAULICS Prize Paper Contest.

D. F. Green

Mr. Green has spent over a quarter century with Williams-White & Co. of Moline, Ill. He was with the company from 1923 to 1931 as a design engineer. Then for the next four years he worked as a tool and die designer for Caterpillar Tractor Co., Peoria, Ill. and with several plants of International Harvester Company.

In 1935 Green returned to Williams-White as design engineer and took over as chief engineer in 1944.

Green is a registered professional engineer and a member of Moline Rotary.

Frank L. Mackin

Mr. Mackin, after an apprenticeship as machinist and tool maker with the Advance Rumely Company at La Porte, Ind., received his technical education at General Motors Institute. He then spent six years in industry with the United States Steel Corporation and the Buick Motor, Chevrolet Motor and AC Spark Plug Divisions of General Motors Corporation, where he worked on special machine design, construction and maintenance. He then returned to General Motors Institute as Chairman of the Machine and Wood Shops and Hydraulic Department, the position he now holds.

Mackin is a twenty-five year member of the American Society of Metals and a member of the American Society for Engineering Education.

John T. Marshall

Mr. Marshall is a nationally known authority on aircraft hydraulic and missile pumps, fuel injection pumps and jet engine controls. He took his degree in mechanical engineering at Lehigh University in 1930; he added a Masters degree in mechanical engineering from Yale in 1934. Early steps in his professional career included service as an experimental and diesel engineer with Electric Boat Co., Groton, Conn., and designer with Ingersoll-Rand Co., Phillipsburg, N. J.

Marshall joined Eclipse Pioneer Division of Bendix in 1935 as a development engineer on direct fuel injection for aircraft. In 1941 he became Chief Pump Engineer, in charge of development and production of all direct injection used on aircraft in this country. Last year, his responsibilities were broadened to include aircraft hydraulic pumps, missile and fuel pumps, jet engine controls and accessories.

If one Answer is "YES" you should enter the

APPLIED HYDRAULICS PRIZE CONTEST

DO YOU...

Design or sell hydraulic or pneumatic components?

Lay out your own customers' circuits?

Design machine tools or special machines or equipment?

Convert machines and equipment to automatic operation?

Build accessories for your own machines?

Assemble your own or customers' machines or equipment?

"Trouble Shoot" on circuits?

Operate or supervise a department in your plant?

Repair and rebuild components?

Have the responsibility for supervising or performing maintenance?

A total of

$1200.00 in Cash Prizes

will be awarded to the papers designated as best by the judges.

Awards

FIRST PRIZE	$500.00
SECOND PRIZE	$300.00
THIRD PRIZE	$200.00
Fourth, Fifth, Sixth & Seventh Prizes, ea.	$ 50.00

No matter whether your job is to sell hydraulic and pneumatic components and systems or design tools, equipment and machines or apply, install, operate and maintain such circuits in your own or customers' shop, you have an equal opportunity to win a Prize.

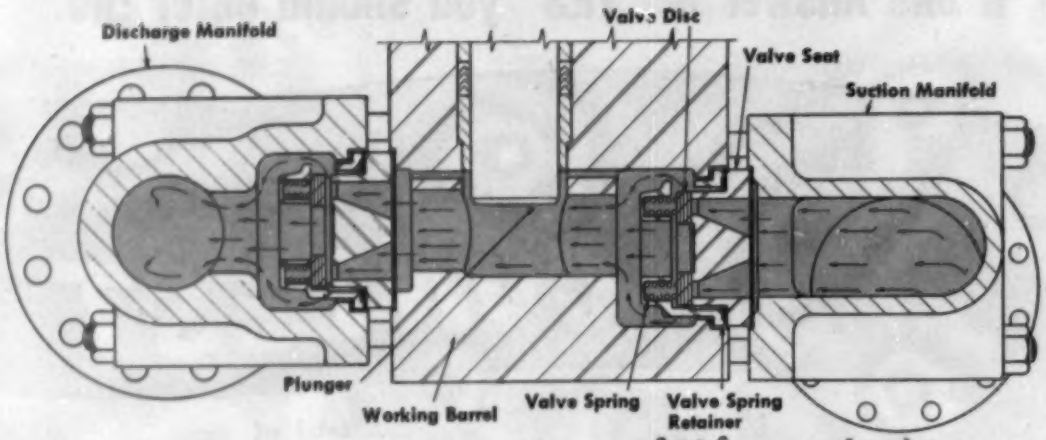
To enter the Prize Contest, simply send for the Entry Blank. The Rules of the Contest and Suggestions to Contestants will be sent promptly with the Entry Blank.

The closing date for the APPLIED HYDRAULICS PRIZE CONTEST is June 1, 1954.

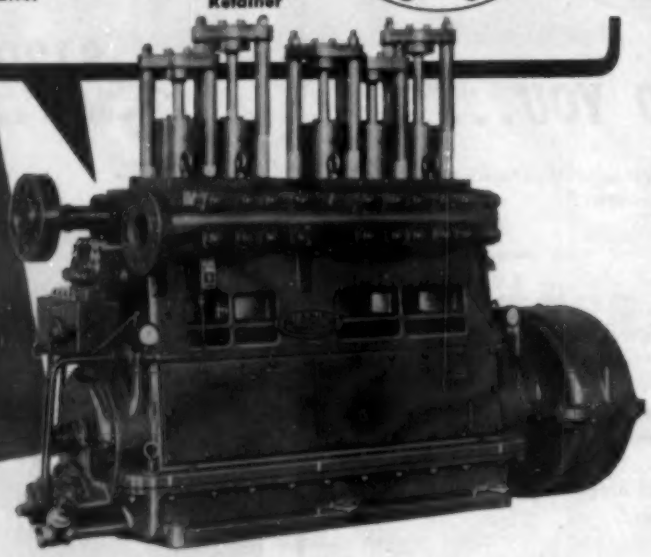
For Entry Blank Write

APPLIED HYDRAULICS PRIZE CONTEST EDITOR

1240 ONTARIO STREET • CLEVELAND 13, OHIO



ENGINEERS: Check these points of Aldrich Direct Flow Design



Aldrich engineers eliminated two right-angle turns in the fluid-end. Now, liquid passes from suction to discharge manifold in a *straight line.* That gave the Direct Flow Pump its name, and set up a whole new concept of pumps, pumping, and pump maintenance. It all adds up as follows:

☐ **Increased operating speeds**—you get whatever volume and pressure you need *from a smaller, lighter, more compact pump.*

☐ **Sectionalized construction**—parts can be replaced at a fraction of the cost of a new fluid-end; also, parts can be made of stainless, bronze, Monel or other special materials—extremely important for corrosive fluid service.

☐ **Maintenance made easier**—no more tapered bores in the working barrel. Manifolds are *not* taken off but slide out on studs—affording room to *lift out* valves as complete units. Packing is easily renewed—note accessibility of stuffing boxes.

☐ **Interchangeable wearing parts**—available among 3, 5, 7 and 9 plunger pumps of same stroke size. This minimizes spare parts costs and inventories.

☐ **Changeable plunger sizes**—in many cases it is only necessary to add new plungers, glands, throat bushings and packing *to the same fluid-end.*

☐ **Drive direct**—by connection to synchronous engine type motor or internal combustion engine; also with integral speed reducer or V-belts.

Contact your Aldrich Representative . . . or write to us direct for complete details on 3", 5" or 6" stroke units.

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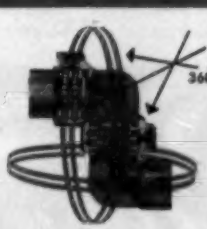

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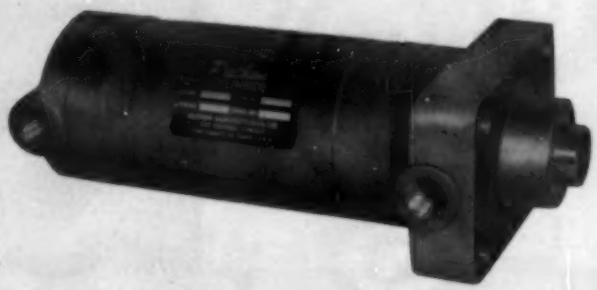

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Houghton's special synthetic rubber moulding process results in a more compact, uniform structure and greater density, which assures longer packing life. These photomicrographs show the difference.

Cross-section of average compound

Coarser, less dense pattern of rubber is indicated in this photomicrograph of a standard packing compound, magnified 240 diameters. Note lack of uniformity.

Cross-section of Vix-Syn compound

Fine-grain density of rubber throughout Houghton Vix-Syn Packing is shown in this cross-section similarly magnified. This compact, homogeneous quality means longer packing life.

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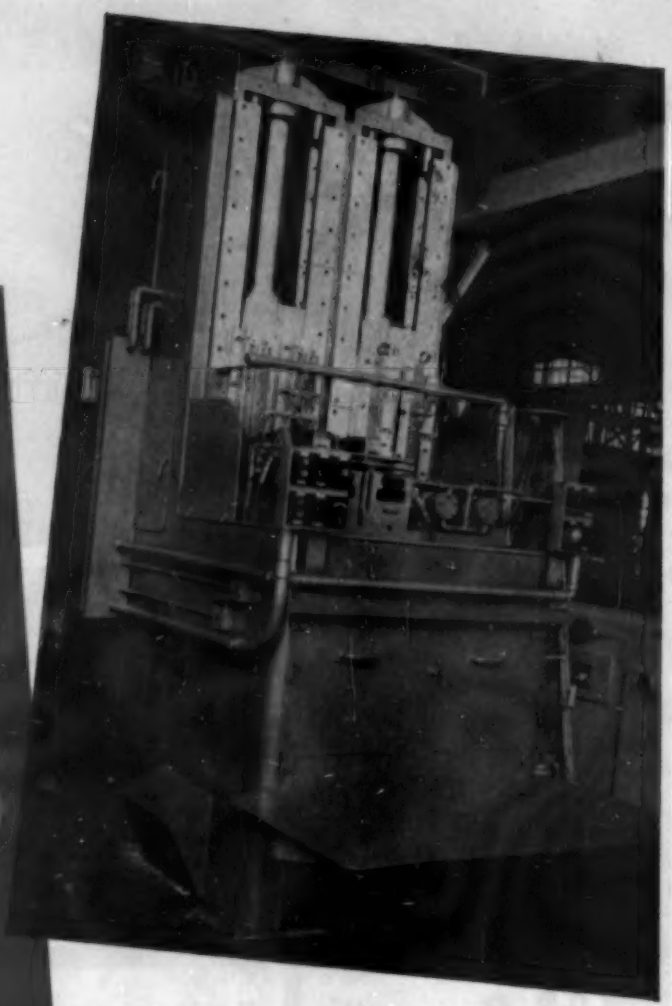

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FOR ALL HYDRAULIC UNITS

TUNE IN . . . METROPOLITAN OPERA radio broadcasts every Saturday afternoon. See newspaper for time and station.

Small graphite boats filled with germanium had to be moved in stages through a furnace. Any jerky motion would cause spillage of this expensive material.

You Can Get Gentle, Smooth Motions With Low Pressure Cylinders

By Joe Clancy

AMERICAN Electric Furnace, Inc., of Boston, Mass., had a critical problem in the design of a germanium furnace. The nature of the operation required that all movements of the germanium material (powdered or molten) had to be extremely smooth; any vibration or shock would result in possible spillage of the germanium or damage to the thin walled graphite boats. It was essential that all movements be as gentle as possible. In addition, fully automatic operation of the relatively long cycle of heating was considered essential to the control of the furnace to insure absolutely consistent results. The high cost and critically short supply of the material were additional factors that had to be considered.

Designers, after careful consideration, chose a low pressure hydraulic system, with cylinders and flow control valves on both supply and exhaust lines. Cylinder travel is controlled by limit switches and solenoid operated valves. The adjustment of the flow control valves and an adjustable stroke mechanism built into the assembly of the special double ended piston rod of the main pushing cylinder assures extremely smooth operation.

Cylinder Sizes

Five of the six operating cylinders are 1½ inch in diameter with ⅝ inch piston rods. The index cylinder is a 2 inch cylinder with a ⅝ inch piston rod. All cylinders other than the main pushing cylinder are stock 500 psi hydraulic units. A self-contained low pressure hydraulic pumping unit provides the power.

The long cycle, four to five hours of heat and melt,

This Month's Guest Editor

Joe Clancy of the Gibson Engineering Company, Boston, Mass. collaborated closely with American Electric Furnace, Inc., on the electrical and hydraulic circuits described in this article.

Joe received his B.S. in Electrical Engineering from Northeastern University in 1939. Prior to World War II he did some design engineering until he was called into the service with the Navy. He gained some valuable experience, both electrical and hydraulic on fire control equipment while in the Navy.

Joe joined the Gibson Engineering Company in 1945 as a Field Engineer and since that time he has worked out of both their Hartford and Boston offices. His company furnishes the New England area with electrical, pneumatic and hydraulic equipment. The application described in this article is a good example of the type of work handled by this company.

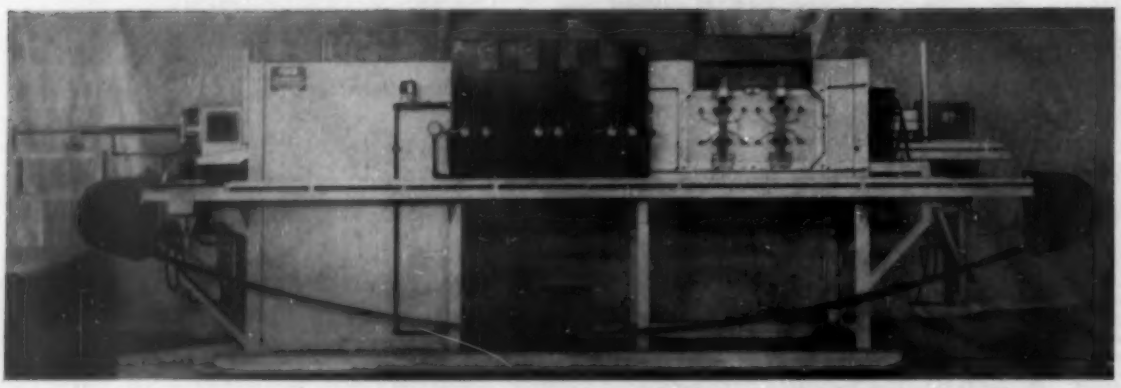


FIG. 1. GENERAL VIEW of the germanium reduction furnace. Major parts shown, left to right: main pusher cylinder; entrance chamber; furnace proper; water jacketed cooling chamber and; exit chamber.

was accurately controlled by an adjustable repeating cycle timer.

During shop tests of this furnace the smoothness of operation was demonstrated by conveying a glass marble through the furnace on a smooth wooden block. The marble, placed on the block on the index conveyor, was moved completely through the furnace without any appreciable movement of the marble relative to the block.

The germanium reduction furnace is a three zone, electrically heated, automatic loading and unloading type, using hydrogen gas for protective atmosphere and reduction of the germanium dioxide. All movements are actuated by cylinder extension or retraction. The index conveyor, fitted with stainless steel plates, runs over a shelf along the front side of the furnace (Figure 1), returning under the shelf. The entire conveyor belt may be loaded with graphite boats, one on each conveyor plate, at one time.

Cylinders Operate Every 15 Minutes

Each fifteen minutes one boat enters the entrance and purging chamber. Individual boats are moved from the conveyor belt to the front elevator table by a horizontally mounted cylinder, then raised to the level of the furnace retort floor by a vertically mounted elevator cylinder. Then the main pushing cylinder, horizontally mounted and in line with the centerline of the furnace, pushes this boat into the furnace muffle. This action pushes the line of boats into the furnace one boat length. At the rear of the furnace one boat is pushed out of the furnace onto the rear elevator. Companion elevator and unloading cylinders lower the boat to the conveyor level and push the boat

Control Table

Action	What Happens	Result
1 Operator turns on pump and control switches at beginning of work day.	Oil exhaust solenoid valve opens, remaining open as long as system is in operation.	(Prevents drain of system when idle)
2 Cycle timer starts timing	circuit 2-3 closes	Relays 1 and 5 are energized
3 Contact R1C-NO closes	energizing V1B	Cylinder No. 1 pushes; cylinder No. 2 indexes conveyor drive wheel
4 Contact L1B-NO and L2A-NO close R4C-NC opens	energizing relays 4, 2 and 3 deenergizing relay 1 and energizing V1A	Push and index cylinders return to normal
5 Relay 2 is energized Push cylinder returns to normal	closing R2C-NO L1A-NO closes, energizing V2B	Elevator cylinders, Nos. 3 and 4, lower
6 When cylinders 3 and 4 are down L5A-NC and L6B-NO open	V3B energizes through L3B-NO, L4B-NO and R3C-NO Deenergizing relays 2, 3 and 4	Load and unload cylinders, Nos. 5 and 6, complete power stroke
7 Load and unload cylinders return to normal (when V3A is energized)	L5B-NO and L6A-NO close, energizing V2A	Raising elevator cylinders, Nos. 3 and 4, to normal position
8 Relay 5 closes	starting cycle safety timer	Alarm will sound if: (1) elevators do not return in normal time; (2) push cyl does not return to normal position; or (3) safety limit switch is operated.
9 Jam in discharge chamber	Limit switch will operate to open Relay 1	Push cylinder (No. 1) will immediately reverse.

(The normal cycle of operation is action 2 through 7 above)

Circuit uses one timer to time cylinder operations . . . a second timer is a safety device

off the rear elevator onto the rear end of the index conveyor.

From the entrance chamber the work progresses into the first of the three zones of the furnace. This is the preheat zone, a short (12 inch) zone. Heating elements of 80-20 nickel chromium ribbon on both sides heat the zone to approximately 650 C (1202 F).

From the preheat zone the work advances into the second temperature zone for reduction of the dioxide. This zone is five feet long.

The third zone is the melting zone. This two foot zone is heated by Globar (silicon carbide) elements to melt the germanium (melting point approximately 1030 C (1904 F). Insulating refractory brick walls and ceiling of asbestos block insulation, heaviest in the melting zone, are used, with a silicon carbide hearth plate beneath the retort the entire length of the furnace.

Immediately beyond the melting zone is the water jacketed cooling chamber. Attached to this cooling chamber is the exit chamber. This, like the entrance chamber, contains observation ports. A safety limit switch in the exit chamber shuts down the entire furnace in the event of any improper spacing of boats in the chamber in relation to the exit elevator.

Cylinder Cycle of Operation

In the starting position both elevator cylinders (Nos. 3 and 4) are in the raised (extended) position. The main pushing cylinder (No. 1) extends, advancing the line of loaded boats through the furnace. Simultaneously, cylinder No. 2 starts its index stroke, moving the conveyor belt to position another boat ready for loading. At this time both front and rear elevator cylinders lower (retract). Then load cylinder (No. 5) retracts, pulling a loaded boat from the index conveyor to the elevator table; the unloading cylinder (No. 6) extends, pushing a boat from the rear elevator table to the index conveyor.

Then both elevator cylinders (Nos. 3 and 4) again raise to their extended position. When these cylinders have come to rest, the operating cycle is complete. All cylinders remain at rest for the duration of the time cycle (15 minutes).

The furnace requires the attention of only one operator and then only for a short time every four to five hours to fill up new boats.

The control circuit is operated by two standard

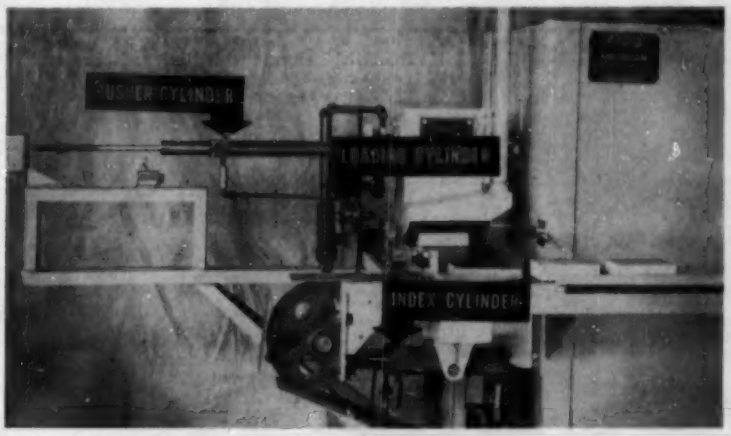


FIG. 2. FRONT VIEW of loading end of the furnace. The pusher cylinder (upper), conveyor index cylinder (adjacent to conveyor drive wheel) and elevator cylinder (vertical, under entrance chamber) are shown. Boats on stainless steel plates of the conveyor are also shown.

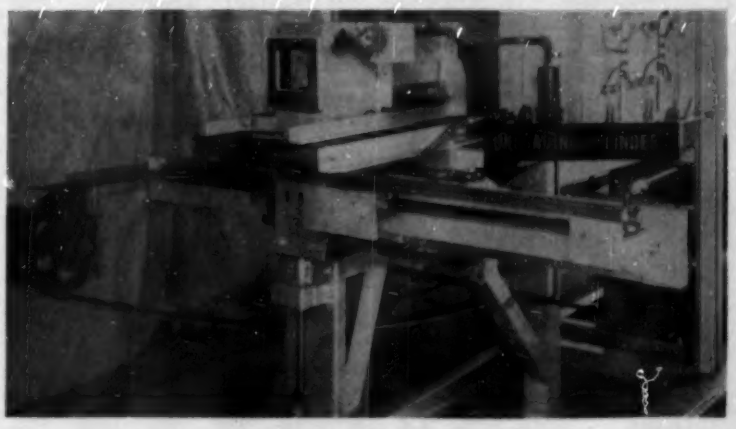


FIG 3. END VIEW of the unloading end of the furnace. The unloading cylinder, water jacketed cooling chamber and idler pulley are shown. The rear elevator cylinder is hidden by the leg of the furnace.

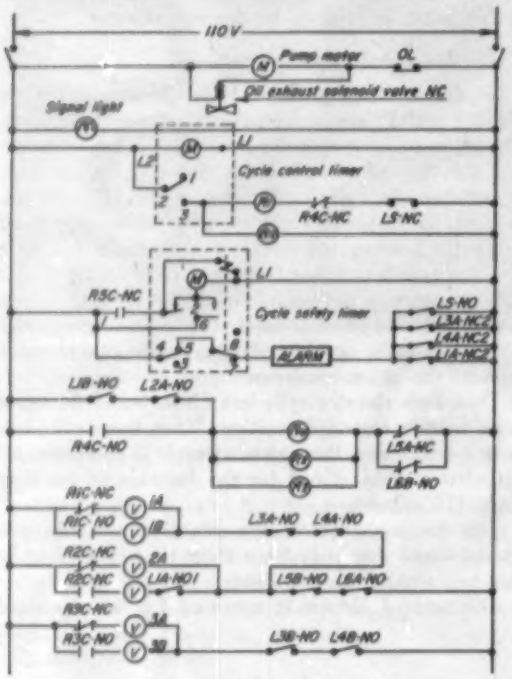


FIG. 4. ELECTRICAL CONTROL circuit with a single circuit repeat cycle timer switch and a reset timer with momentary-contact control switch. All units are shown at "rest" position.

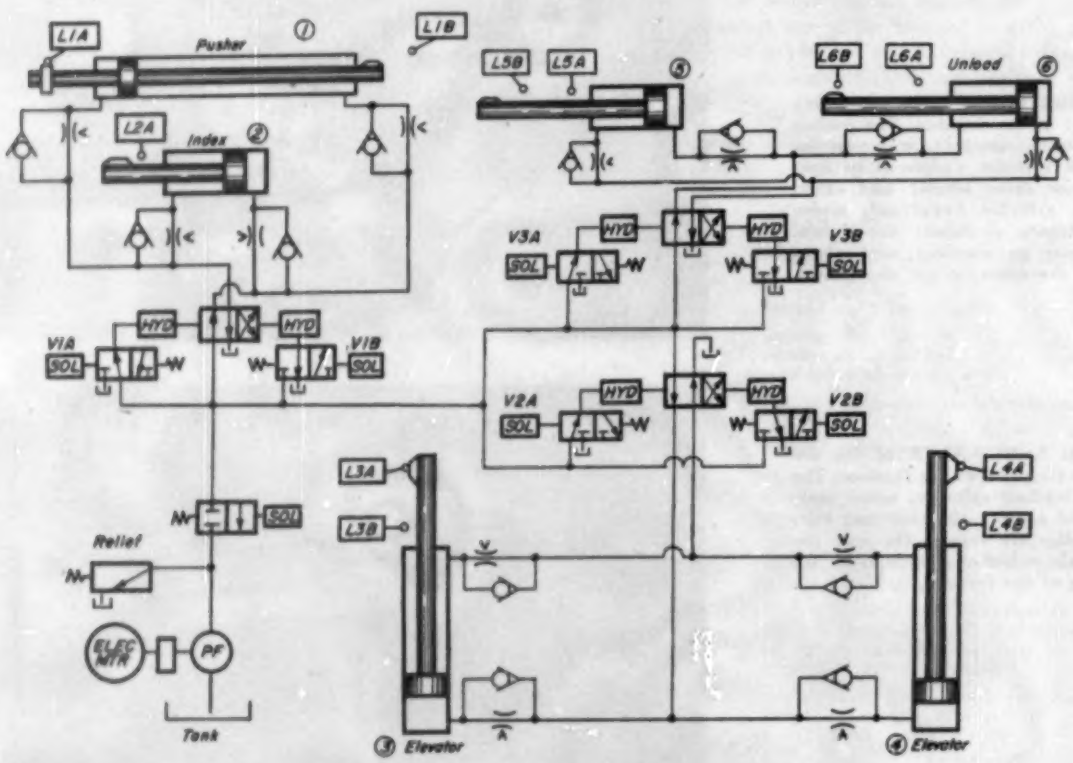
electrical timers; an adjustable, repeating cycle timer and an automatic reset timer. When the fifteen minute preset interval has expired, the cycle timer acts as the starter of the cycle of operation by energizing the pilot solenoid V1B, initiating power stroke of cylinders Nos. 1 and 2.

From this point on, the balance of each cycle is controlled automatically by action of limit switches and relays. No cylinders will operate at any time unless all preceding portions of the cycle are completed properly. The reset timer is synchronous motor-driven with automatic reset within which a complete cycle of cylinder operation must be completed. In case of malfunctioning of cylinders this timer will sound an alarm.

The control sequence table outlines steps in sequence of operation.

The germanium reduction furnace is now in successful operation. The low pressure hydraulic system with limit switch operated cylinders and cycle control by electric timers has given fully automatic operation that has provided critically accurate and smooth functioning movements necessary for the safe and efficient operation of this furnace.

FIG. 5 HYDRAULIC circuit with limit switches and reversing solenoids.



How does a hydraulic servosystem operate?

What are the necessary components?

To answer these questions this article describes . . .

An Electro-Hydraulic SERVO PUMP

By Norton Williams

A SERVO pump is one of many examples of a hydraulic mechanism used to exploit the advantages of modern fluid mechanics for feedback type control applications. It is a pump whose amount of stroke and direction of output flow can be varied at will, and which is designed specifically for servo circuit usage. The functions it is intended to fulfill are sufficiently broad, so that a description of the pump as a complete, packaged unit, with a listing of immediately associated circuit components, should present a fairly comprehensive example for an illustration of hydraulics at work in a servo circuit.

The electro-hydraulic servo pump unit is essentially an electrically-controlled, variable-delivery, positive displacement, hydraulic pump. The combination of this pump and a rotary or linear hydraulic motor forms an electrically controlled hydraulic transmission, with the motor acting as the output member. These transmissions are usually designed especially for use in remote control operations and high-response servo systems employing electrical feedback. However, servo pump units can be designed so that they are entirely mechanically controlled.

The transmission may be considered as a power amplifier when viewed from the electrical signal input, of about five watts, to the mechanical power output of several thousand watts. Various sizes of transmissions have been built, having output capacity ratings from one to 400 h.p.

An electric motor, auxiliary drive pad on an airplane engine, air turbine, hydraulic motor, or other prime mover which will provide adequate power and substantially constant speed for driving the servo pump unit may be the basic power input to the transmission.

Direction and rate of fluid flow from the pump unit is controlled by the application of a small electrical signal to a solenoid, which is usually included as an integral part of the pump unit assembly. Therefore, the velocity, position and direction of motion of the output member and the load is under control of this electrical signal and such feedback circuits as may be desired. Speed changes are smooth and stepless.

High Power to Weight Ratio

The servo pump unit and its associated hydraulic motor are designed to have a high power-to-weight ratio, high torque-to-inertia ratio, low inertia of rotating parts, high resonant frequency, reliability and versatility of application. The hydraulic motor is normally of a fixed stroke design, which results in the transmission having constant torque and variable speed characteristics. However, variable stroke hydraulic motors can be designed which will reverse these characteristics; that is, provide a transmission having characteristics of variable torque and constant speed.

Power loss for control purposes is low in a servo pump unit because metering valve action is confined to a low-power level hydraulic system. This is the stroking system. It is a part of the pump unit, and is usually designed to operate in the pressure range of 100 to 300 psi. The stroking system controls the amount and direction of stroke of the main power pump, which may operate at pressures up to 3000 or 4000 psi. Pressure drop across the ports of a metering valve, with its inherent losses, is avoided in the main power

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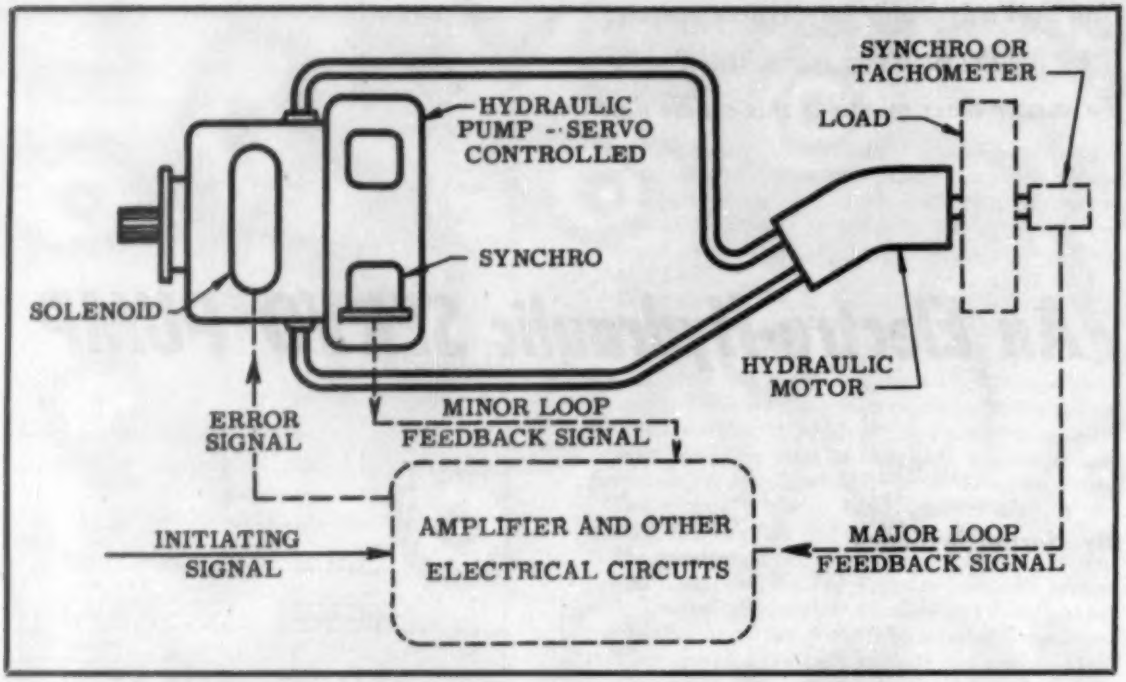


THIS SIMPLE LAYOUT shows a servo pump in combination with a hydraulic motor and the electrical control circuit.

system. That is, the final power output from the pump is not dependent upon pressure-drop methods of control, but is determined by the amount of flow which the stroking system directs the power pump to develop, and by the actual resistance offered by the load.

In a control system employing a servo pump, the variations in gain resulting from a change of load are negligible as compared to those which may exist in the same circuit if control is exercised by a valve metering directly in the main power line.

The servo pump unit is normally controlled by an electronic or magnetic amplifier. In a typical example, an electronic amplifier should be capable of supplying to the solenoid a maximum differential current of approximately 28 ma, dc and a sum current of 34 ma, dc.

Pump Sub-assemblies

Principle sub-assemblies of the pump unit are:

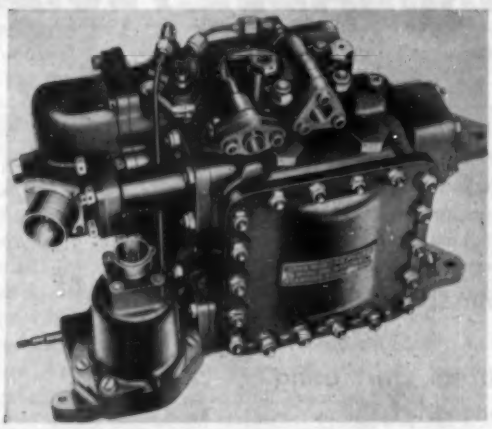
Power pump. It is usually a nine cylinder pump housed in a pintle-mounted yoke to which is connected the stroking piston. The flow and pressure generated in this pump are carried through passages in the yoke and hollow pintles to external fittings, at which point tubing connections are made to the hydraulic motor. The power pump is a positive displacement pump of very high volumetric efficiency. Its piston and cylinder block assembly is rotated continuously in one direction at constant speed by the basic power input. This is accomplished through a drive shaft and universal linkage. The yoke in which the piston and cylinder block assembly is housed is rotatable about the pintles, usually through a 60° arc (30° on each side of "center", or zero flow position). The amount of stroke of the power pump pistons is dependent upon the yoke's position within this arc. In effect, the power pumping elements (pistons, cylinder block and valve block), since they are enclosed in the yoke, swing about the pintle axis as if they were hinged on the pintles. When the yoke is in its center position it is directly in line with the axis of rotation of the drive shaft, pistons and cylinder block assembly. Consequently, there is no relative motion between the pistons and the cylinder block in this center, or zero, position. Linear motion of the pistons in the cylinder bores starts to occur as the yoke swings away from center.

Control solenoid. Usually differentially wound, so that it can be controlled by a push-pull amplifier. However, it may be designed differently if desired, such as a solenoid employing a permanent magnet field and reversible current control with a wound armature (similar to the voice coil in a radio speaker). The solenoid is usually designed to provide linear response, and to have a resonant frequency of 120 cps or higher. The purpose of the solenoid is the actuation of the control valve in the stroking circuit, which in turn controls the direction and rate of output flow from the power pump.

Control valve. Sometimes called a metering valve, or pilot valve, or follow-up valve. It is controlled by the solenoid, and meters the stroking circuit flow to and from the stroking cylinder. It can be designed to provide either velocity or acceleration inner-loop feedback. It is usually designed to have high response, to

resist vibration and other external acceleration forces, and to provide accuracy of stroking control. Through appropriate arrangement of the inner-loop feedback and control valve, the acceleration or velocity of fluid flow from the power pump can be made proportional to the electric input signal.

Stroking cylinder and piston assembly. This positions a yoke, which houses the pumping elements of the power pump. By moving this yoke to different positions, the stroke of the power pump is varied, and the direction of its output flow can be changed. In some cases a mechanical feedback is provided from the yoke to the sleeve of the control valve, which results in an



A TYPICAL servo pump, weighing approximately 15 pounds, delivers 4 horsepower continuously and 8 horsepower intermittently.

inner-loop velocity feedback. In most of the recent servo pump units the inner-loop feedback is either left out completely, or replaced by a yoke-driven synchro (which is included as a part of the pump unit). This synchro provides electrical, instead of mechanical inner-loop feedback.

Stroking system pump. This pump, with the control valve and stroking assembly, is often referred to as a hydraulic amplifier. The pump is usually a small gear-type pump, driven by a mechanical take-off from the power pump drive shaft. The flow from this pump is metered by the control valve to provide the direction and amount of motion desired for "stroking" the power pump (that is positioning the yoke). A small stroking circuit relief valve controls the pressure produced by this pump, usually regulating it to a maximum of about 250 psi, although on some units this may be as low as 60 psi or as high as 600 psi—depending upon the design which is dictated by the stroking rate desired and force required to attain it.

Replenishing pump. A small gear pump similar to the stroking system pump. It provides super-charging pressure to the power pump inlet, and replenishes fluid, so that all circuits are fully supplied at all times. Check valves port its flow in the appropriate direction to replenish the low pressure power pump line.

Various relief valves, check valves, linkages, gearing, filters, etc.

Synchro. This synchro is included as a part of the pump unit only when it provides a useful function in the feed-back circuits in the particular application in which the servo pump is to be used. When provided, this synchro is usually driven through a rack and pinion from the power pump yoke. Therefore, its output reflects the position of the yoke, and hence is proportional to flow from the power pump.

Position limiter. This provides means by which the servo pump may be made to automatically limit the travel of the load. A mechanical (or electrical) feedback of the load's position is required to accomplish this function. The inherent design of the servo pump allows it to provide dynamic braking, and hence makes it particularly capable of accomplishing this limiting action smoothly and forcefully. Provisions for positional limiting are optional, since in some applications it is not a necessary function.

Pressure limiter. This provides means for automatically stroking the power-pump toward zero-flow position whenever the main-line pressure exceeds the predetermined maximum. This limiter is usually in addition to main line relief valves. Its principal advantage is that it prevents over-loading the pump driving source and reduces heating during relief-pressure periods. If a relief valve only is used, then the drop across the valve will maintain the maximum load on the pump driving source, which may be a critical consideration in installations such as those using an electric drive motor of minimum capacity. The purpose of the relief valve in conjunction with the power limiter is the providing of quick, initial relief (especially for transient surge conditions). Then, as the power limiter comes into action, the power pump stroke and output flow are reduced substantially to zero, and remain in this situation as long as the maximum pressure condition exists. Therefore, during this period there is no flow across the relief valve.

Over-ride mechanism. This feature can be included when it provides a desirable function. For instance, in an aircraft control installation it would permit the pilot to over-ride the electrical system and to control the hydraulic system manually.

Main housing (with mounting provisions, drive connections, hydraulic and drive fittings) into which all of the preceding items are mounted.

System Components

The pump unit is intended normally for use in a system which has:

(1) *Electronic or magnetic amplifier.* For supplying the electrical control signal.

(2) *Oil cooler.* For cooling the oil from the pump unit when the duty cycle, power requirements, and ambient temperature are such that cooling is necessary. Recommended maximum oil temperature is 180° F. This temperature can usually be exceeded, by 15° or 20° without damaging the equipment.

(3) *Oil reservoir, or sump.* For oil storage and for allowing expansion space for the oil. In installations

Continued on page 84

A technical forum on:

INDUSTRIAL NONFLAMMABLE FLUIDS

- Can present day nonflammable fluids be used satisfactorily?
- What changes must be made to machines using nonflammable fluids?
- Will machine tool users start using nonflammables extensively?

Chairman:

J. C. Van Gundy
The Texas Company

Panel Members:

H. Stuart Litzsinger
Monsanto Chemical Company

W. H. Millett
Carbide and Carbon Chemicals Company, Division of Union Carbide and Carbon Corporation

Don P. Morrell
Ford Motor Company

James Robinson
Vickers, Inc.

Carl E. Schmitz
Crane Packing Company

Industrial nonflammable fluids were the subject of a technical session at the National Conference on Industrial Hydraulics last October. During this session, the panel answered questions from the audience. Members of the panel represented producers of fluids, a packing manufacturer, a hydraulic component manufacturer and a large user of hydraulic machinery.

Are packings suitable for synthetic fluids also suitable for petroleum fluids?

SCHMITZ: I have to answer that by saying this: A great many packing manufacturers are using synthetic binders or synthetic rubber cores. I think that a packing that utilizes a synthetic core which is very rapidly affected by chlorinated hydrocarbon, or some of the synthetic lubricants, wouldn't be successful in the synthetic fluids. Yet it might be entirely satisfactory on petroleum products. It requires a careful study of just what the problem is.

What packing material would you recommend for use with water base fluids?

SCHMITZ: I would first have to know the problem, the speed and temperature and pressure, all of which are important elements. Knowing these factors, I think a satisfactory packing could be recommended with little difficulty.

Have you data on which packing may be used with various of the nonflammable fluids?

SCHMITZ: Yes, we have data on almost any problem. If you have a specific problem I am certain our engineering organization would be glad to have you discuss it with us, or any other packing manufacturer, I am sure, has the same thing.

Will Pydraul burn? What would be its ignition temperature?

LITZSINGER: The answer to the first portion of the question is quite simple—yes. Pydraul is fire resistant enough to afford at least the minimum protection required for die casting machines, the particular application for which it was developed. But it will definitely burn; in fact, we feel that there is nothing, if you put enough effort on it, that we could not make burn. As for the ignition temperature of Pydraul, there again you would have to first describe the conditions under which you would be testing fluids. I might point out that the ignition temperature is greater than 1100 degrees Farhenheit.

Would you compare the fire resistance of the halogen compounds used as hydraulic fluids with good hydraulic oils?

LITZSINGER: I think that is the answer right there. The halogenated fluids are excellent in fire resistance. However, you will have to have a satisfactory fluid as a hydraulic fluid. It is no good as a fluid. It is of little practical value.

To what extent do the fire resistant fluids vary as heat conductors as compared to equivalent viscosity petroleum oils?

MILLETT: Actually, I don't believe there is as much data in this connection as there should be. From what we know, we think that most of it or several of the types are probably in the same range as our petroleum oils. We wouldn't expect too much difference from the point of view of heat conductiveness, based on some background I have had in other fields.

Have any standards been established to satisfy casualty and fire insurance underwriters as to what constitutes a nonflammable fluid?

MILLETT: There are probably almost as many flammability test procedures as there are people in this room. There is a very good need for some standardization along this line. The difficulty has been that we are interested in different operating conditions.

H. Stuart Litzsinger

C. E. Schmitz

What is a good flammability test for one set of conditions is not a good flammability test for another type of operation. There have been specifications for military hydraulic fluids of a nonflammable type that have been included in as many as six different flammability tests. The insurance companies are always very much interested in this and in some instances they have designed their own flammability tests.

I have here a pamphlet from Factory Mutual Engineering Division. This is their Loss Prevention Data sheet 7-2, Hazardous Materials and Processes, in which they discuss hydraulic fluids or nonflammable fluids, the tests they have used, and now I am quoting—

> "These tests were made to simulate the discharge from a fractured high pressure pipe or fitting by discharging the fluid at 1000 psig. Pressure through an atomizing nozzle into a small furnace open at the top and bottom. A gas flame in the furnace served to heat a metal plate to 1200 degrees Fahrenheit. The gas flame and heated plate were used as an ignition source for the spray. Flash and fire point tests and autoignition tests were all made on each of the fluids.
>
> "The tests of the less hazardous fluids showed that each would burn when finely atomized and subjected to a strong ignition source but when the ignition source was removed, burning of some of the fluids stopped almost immediately and burning of the others continued at a greatly diminished rate."

There have been other conflicting reports from other places as to just where you draw the line, as to what is flammable and what is nonflammable. That is why I like to think of it as a more or less relative term, one we can't define too accurately. I know the underwriters' laboratories are working on this. They are trying to develop a method for measuring this characteristic of flammability.

What are some of the maintenance factors found desirable with synthetic fluids, particularly aqueous base fluids?

MILLETT: I could take off at some length on that but I think I will mention a few of the high points. One of the important aspects of this problem is the installation. In installing a water base fluid it has been the experience of those who are marketing such fluids that cleanliness is very important. If you have an old system that has been in use for several years with petroleum oil, there is a lot of accumulated sludge that is going to be softened by the water base fluids and give rise to contamination. In nonflammables that is something you don't have to have any more than you want to have with a hydrocarbon system.

If you have an old system, you should be very careful to get it as clean as possible.

Another point that should be considered is paints. All of the synthetic type nonflammable fluids that we know about today have some softening effect on most types of paint. If you have a painted system, before installing any nonflammable type fluids, you should take care to check as to the susceptibility to that fluid. There are resistant paints available and if you are fortunate to have resistant paints, or don't have any paint in your sludge, you are all right. But if you have a paint that is softened it can be a headache and should be removed before the installation of fluids.

On packings, it has been our experience with the aqueous fluids that you do not need to make packing changes unless you have packings that were deteriorated initially. The conventional rubber type packings that are used with petroleum oils have been found to

W. H. Millett

James Robinson

be completely satisfactory with the aqueous base fluids. I will make one exception. We have had a few instances where we get excessive softening of cork impregnated seals, impregnated with rubber. Aqueous fluids will soften them. Other types can be substituted for the cork impregnated type of packing.

Your filtering is very important. You may have contamination by petroleum sludge. You may have contamination by paint.

When we first introduced water base fluids for industrial service, we anticipated a good many problems due to loss of water during its use with resultant increases in viscosity and loss in mechanical efficiency. I think everyone has been surprised that with proper maintenance you can maintain water content without a great deal of attention. I recall one instance in a steel mill where an aqueous fluid was used for soaking pit controls, through two summers, and in the intervening years our laboratory was following the water content very closely, expecting most of the water to evaporate during this period. Actually, in sixteen months of operation the water content decreased only .3 of one percent.

There are other instances, of course, where water losses have been higher. You will get high vapor pressure and more water loss. It is not recommended that such fluids be used at temperatures in excess of, let's say, 150 degrees Fahrenheit.

Are larger filters usually found desirable with aqueous base fluids?

MILLETT: I don't think larger filters are necessary, unless you are subjecting the filters to a lot of service. If you've got a lot of material to be filtered out, yes. If you are going to use the filters to remove the paint, I would say you need larger filters.

One point on filters that applies, I think, to actually any additive type of oil is that the activated spray type filter is not satisfactory for use with aqueous fluids. In fact, they are not really suitable for any fluids that have high additive content. Filters of other types are recommended in such instances.

What is the effect of synthetic oils on cadmium plated parts?

MILLETT: In most industrial installations you don't run into cadmium plated steel. I think with the industrial fluids that are now in use you don't have much of a problem with such metals.

What is the effect of various nonflammable fluids on water pollution of streams? There are very strict laws in certain states.

LITZSINGER: I don't have any figures on it, but the solubility of Pydraul in water is something on the order of one-third of one percent. Further, it will sink to the bottom.

MILLETT: Water base fluids would, of course, be soluble in the stream. The other ingredient of hydrolube is glycol which doesn't present any problem. The thickener that is used in the hydrolube is very similar in properties to low molecular glycol. It is a polyglycol type of material. It is also water soluble. The only question would be the additives which are present in a relatively small percent, less than 4 percent overall, and there would generally be the common salts, or salts of esters of organic compounds. I would not anticipate any difficulty with stream pollution from such materials.

Because some of these fluids will hold solids in suspension, is 100 percent filtration necessary?

LITZSINGER: We have had no report of difficulty because of the suspension of particles in the fluids. However, because of the nature of the fluid we would recommend 100 percent filtration. I say that because the phosphates are exceptionally good detergents. No matter how thoroughly you think you have cleaned a system, the fluids will get in the cracks and crannies and scavange some of the varnish, so those should be filtered out.

MORRELL: We found the same thing in the scavanging agent of this particular nonflammable material. We had to have 100 percent filtration, of necessity, because of the type of fluids. It is advisable, I believe, to use a mechanical type filter of rather fine filter characteristics.

MILLET: I think there is probably no definite answer to the first part of your question because the fluids will vary, even within the groups. I know there are

some water base fluids that incorporate detergent types of materials and that do give quite a lot of that detergent action. All of these fluids, both water base and the non-water base, have different and unusual solvency and solvent characteristics. I think with the growing use of these materials, filter manufacturers will give you definite recommendations.

What are your developments toward cold weather, low temperature operation?

LITZSINGER: There are some areas where a general use fluid will not be applicable. Our fluid was developed to operate roughly between the temperatures of 40 to 160 degrees Fahrenheit.

MILLETT: Fortunately, one of the bonuses we get with the water base type fluid is that, since they are really essentially anti-freezes that have been fixed up for industrial hydraulic service, they have very good viscosity temperature characteristics with the limitation that we do not recommend their use above 150 degrees F. They can be prepared in any viscosity range so you can select the viscosity to suit your purposes. The points are much lower than you need for industrial service, ranging around minus 50 F for the industrial type fluid, but the viscosities are such that they will be suitable for use at zero degrees without much difficulty.

What is the solubility of air in the nonflammable type of fluids? If it is less soluble than in petroleum base fluids, would it be practical to use a smaller reservoir?

LITZSINGER: We have no actual data on the solubility of air in the fluid. All we can say is that when you get down to the consideration of smaller reservoirs you have other factors that are going to enter into the design as much as the foam or insolubility.

ROBINSON: I don't think the use of any type of fluid should alter the size of the reservoir that has been found necessary with the fluid you are now using. Basically, the reservoir is based on the heat from the machine or its efficiency. Don't expect miracles. The change in the fluid will not increase the efficiency. Therefore, the oil content or the natural radiation tendency of the machine should remain as it is.

If you switch from the petroleum oil to a nonflammable oil, would there be any effect on pipe threading compounds?

MORRELL: We had some, not too much. Some of the pipe compounds are presently available on the market. There are several pipe compounds on the market that are completely adequate that have sealers for the use of nonflammables.

MILLETT: We have had some very interesting reports. Using the same type of pipe compounds, we get diametrically opposite conclusions. Some people will say, "This pipe compound is fine." Others will say, "We can't use it." I think you are aware, that a lot of it depends on the overall maintenance practices. But there are certainly resistant compounds for, I think, all of these materials.

If water addition is necessary to water base fluids, is it necessary to add distilled water?

MILLETT: You should use distilled, deionized water. If you use a hard water, it is possible that you will precipitate some of the inorganic inhibitors that are in the fluid.

J. C. Van Gundy

How much oil can be tolerated in a sump that has a petroleum oil when you replace that oil with a nonflammable fluid?

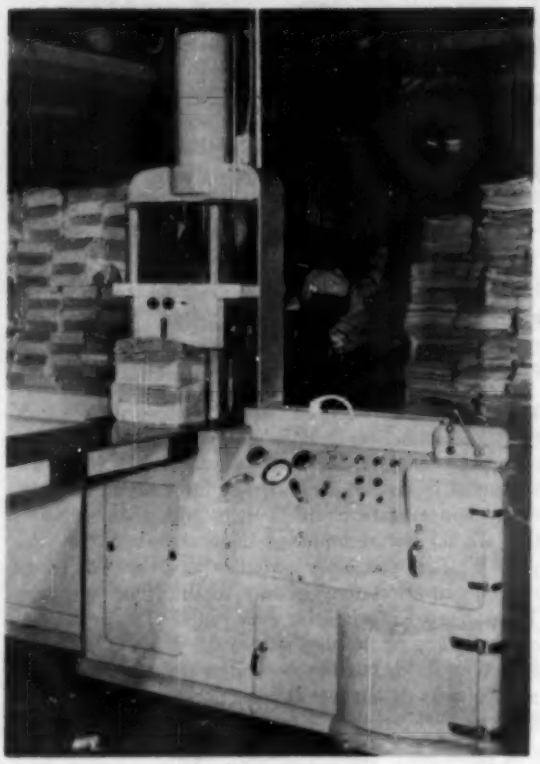
LITZSINGER: Our recommendations are that the system be drained as completely as possible; that is, the pump should be drained and the lines blown out. Operation will not be affected by a mixture containing 10 percent petroleum fluid. However, it is the fire resistance that you have to think about. Fire resistance of the mixture will be greatly decreased.

MILLETT: I think that is a very important point, and in this business of mixtures of oils with the nonflammable type of fluid, you are losing what you try to get. Of course, oil and water are not mixable but while in circulation they exist in the form of emulsion and we never encounter difficulties with small percentages at 5 to 10 percent of petroleum oil. However, we strongly recommend that as soon as possible you try to get that oil out. The oil will rise to the top of your sump. You can siphon it off or else drain your system and use that contaminated oil for flush runs for subsequent installations.

VAN GUNDY: From the discussion, it is apparent there is a definite need for nonflammables for industrial type equipment and that need is going to grow. Secondly, that products of several types are available and are giving completely satisfactory performance in the field and have done so for the number of years that they have been applied. Third, that if you are considering using such a fluid it is necessary that you make a complete study of your conditions, consult with the fluid supplier and perhaps your packings supplier.

All papers presented at the ninth annual NCIH, October 1953, *are included in the Conference Proceedings. Copies may be ordered from John G. Duba, Conference Secretary, National Conference on Industrial Hydraulics, Illinois Institute of Technology, Chicago* 18, *Ill.*

FIG. 1. Air powered paper bundler can complete a cycle in three seconds.



Modern newspaper presses run off a ton of paper every 3 to 8 minutes. Speed of distribution must match this high printing rate. Special conveyor layouts and ingenious bundling machines reduce handling time.

Want Faster Operations? USE AIR CIRCUITS

THERE'S a great amount of engineering going into the production of a daily newspaper. Aside from the design of the modern printing press, considerable engineering effort has gone into efficient plant layout and the development of equipment for handling paper rolls and for moving the completed newspapers to the delivery trucks.

Realizing that the reduction of operating costs in a newspaper plant largely depends on better equipment, the Toronto Daily Star has for many years carried out research in methods of newspaper production.

One of the machines which has been developed by the engineering group is the Wallastar Automatic Bundler, Figure 1. This equipment is now in use in the mailing rooms of more than 25 daily newspapers. According to T. R. Sykes, who is manager of the research and engineering department at the Toronto Star, "Air is used to power many of the motions on this equipment for several reasons. A 100 psi system will develop the required forces when using cylinders of optimum size. The high speed which is essential, can be achieved with air by valves and piping of reasonable size. Air motions are readily controlled with electrically operated valves. Also using a central compressor station of adequate capacity permits installation of as many machines as desired. Further, the care of air operated equipment can be readily understood by the plant maintenance staff."

While the newspaper bundler performs a specific packaging operation, the design of this equipment overcomes some problems which confront designers of many air powered machines. Design problems in-

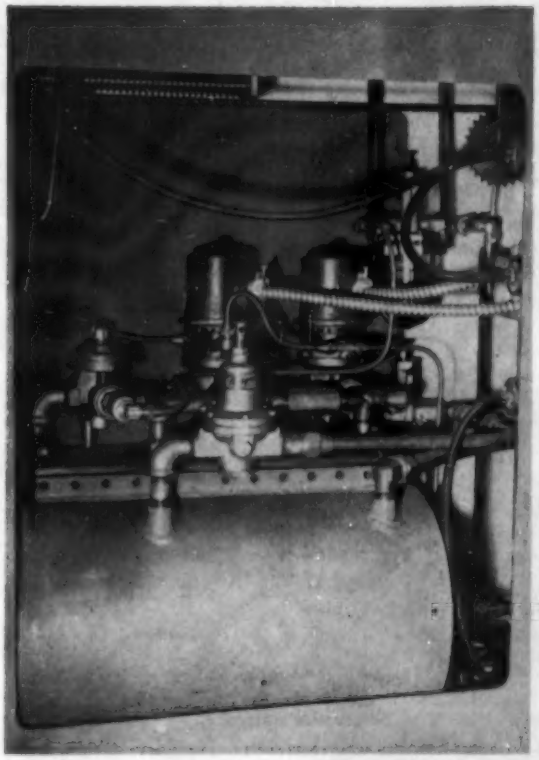
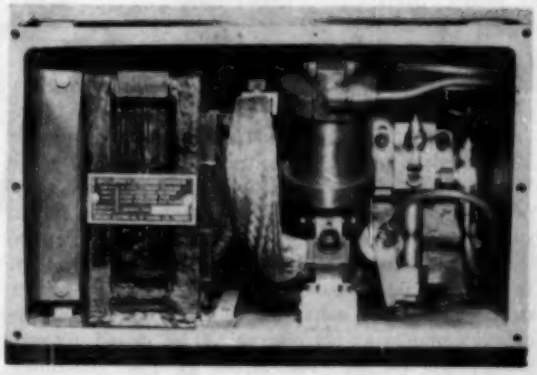


FIG. 2. Air valving for controlling the main cylinder and auxiliary cylinders, are mounted in limited space. Ample access is provided to permit servicing. Automatic oilers keep the valving lubricated.



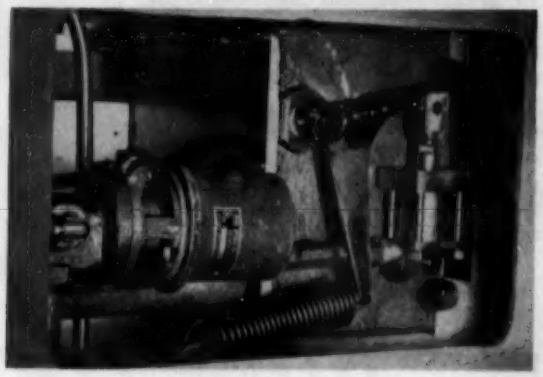


FIG. 3. Above. Welding mechanism for wire tying the bundle.

FIG. 4. Below. Air operated clutch on the wire feeder.

clude selection of components to perform a fairly complicated cycle in less than 3 seconds. These components must be mounted in a compact enclosure, and must be accessible for maintenance.

The bundler is a high speed production machine which automatically wire ties newspaper bundles. A main air cylinder, controlled by valves in Figure 2, compresses the bundle, and after wire has been fed under the bundler, there is an air powered wire cut off. Air cylinders then power folder arms up the sides of the bundle to form the wire around the bundle. When the folder arms reach the top of the stroke, the welding operation is initiated. Two air cylinders, Figure 3, go into operation. One is the weld jaw cylinder the second is the knock flat cylinder.

Other auxiliary operations are performed with air cylinders. The paper bundles feed in and out of the machine on a specially designed conveyor which avoids wrapper creep and skewing of the bundle. Stop rods are actuated by air. Air also powers a conveyor clutch, a table lift cylinder, a bundle positioning cylinder, and a wire feed clutch seen in Figure 4.

Solving Space Problems

The photographs, showing the installation of much of the air equipment, indicate some of the space problems which had to be overcome. Location of the welding mechanism, Figure 3, required using the piston rod of the main cylinder as an air supply line. This weld mechanism is in an enclosure mounted on the end of the main cylinder piston rod; therefore, it moves vertically with the piston. The main piston rod is drilled. The air pressure tube lines, seen in Figure 3, are connected between the main piston rod and single acting air cylinders.

How to Save Air

The valves shown in Figures 2 and 4 are 3-way poppet type valves. Stop rod and conveyor control valves are the same type. A main cylinder sequence pilot valve is a 3-way valve which is mechanically operated by a cam on the base of the right hand folder arm. This valve initiates the down stroke of the main cylinder. Another small push-pull valve is provided on the panel to control the air which operates the three main control valves. With this valve closed, it is impossible to operate any of the main air control valves.

A very unique feature of the air circuit is the air saver valve shown in Figure 5. Figure 5 is a simplified drawing of the air saver circuit and does not show the other valving of the bundler.

The question: "Can air used on the forward stroke

High Speed Air Circuit

of a cylinder be stored and used to return the cylinder?" is often asked. The valve and circuit in Figure 5 does exactly that. The circuit is patented by the Toronto Star Ltd. On many air presses, where a powerful operating stroke is required and the return stroke requires much less power, this circuit can be used to save air by using the air to return the cylinder. In this circuit, Figure 5, air at the end of the power stroke is partially exhausted to the other end of the cylinder and to an air reservoir. This stored air provides power for the return stroke when the remaining air is exhausted from the power stroke.

The air saver valve includes three separate poppets. On the power stroke, high pressure air flows from the supply line to the top of poppet "C". With poppet "C" in the raised position, air pressure passes through to the top of the cylinder. During the downward power stroke, air discharged from the rod end of the cylinder enters the air saver valve, passes around poppet "A" which is in the raised position and then exhausts to the atmosphere.

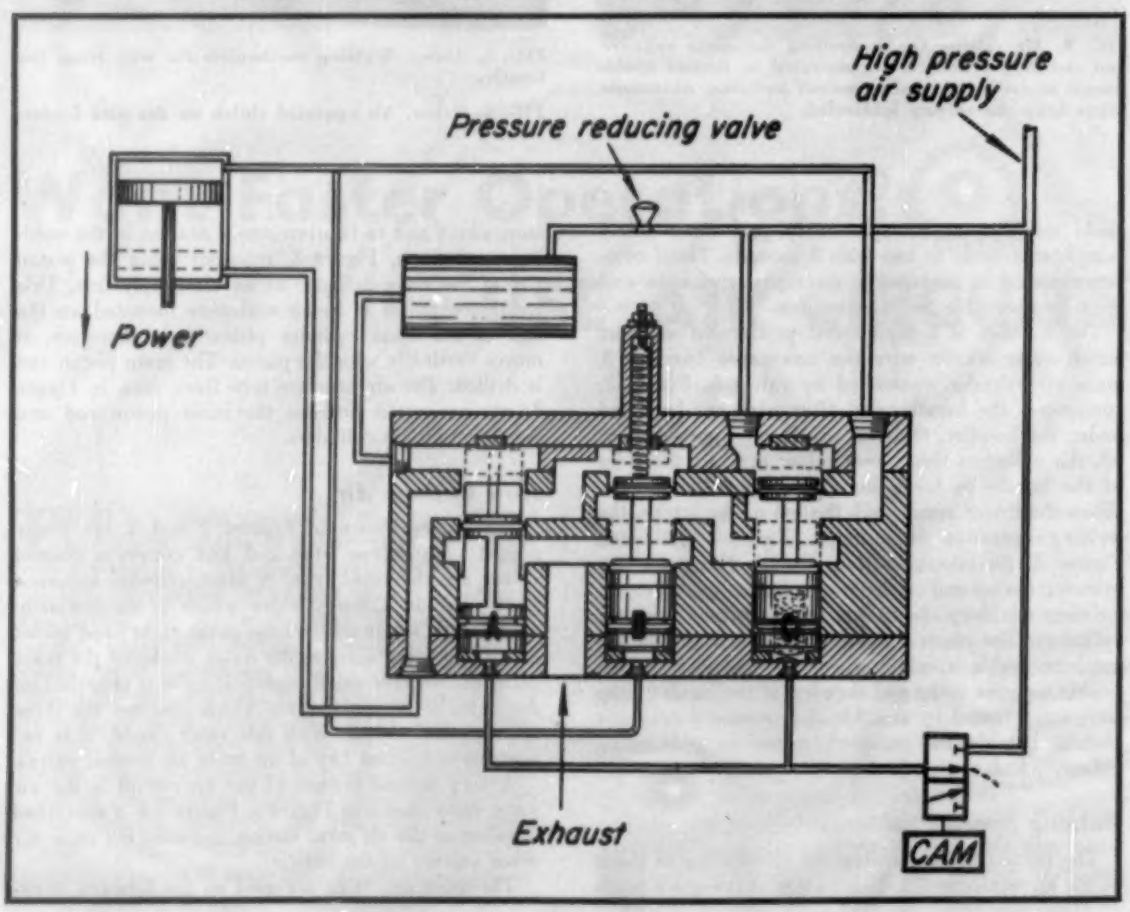
To permit the return stroke, poppet "C" is in the lower position. This cuts off air from the top of the cylinder. Popet "A" is also in the lower position to block passage of air from the cylinder rod end to exhaust. Compressed air from the tank now passes through the air saver valve at poppet "A" to the line leading to rod end of the cylinder to raise the cylinder.

The poppets "A" and "C" are pilot operated by a 3-way sequence valve. When this valve is open, the pilot lines are open to exhaust as shown. When the valve is closed, air pressure is applied to the underside of the poppets to raise them.

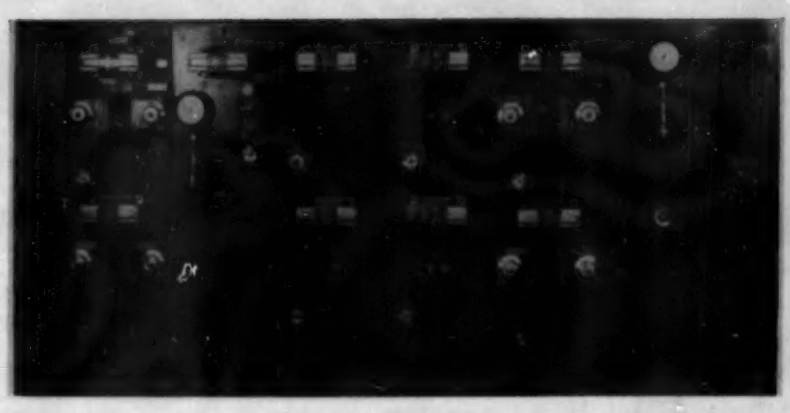
When "C" is closed, high pressure air is pressing on top of its upper disc; however, because the diameter of the lower end of the poppet is greater than the diameter of the upper disc, pilot pressure is able to raise the poppet. This raising force is assisted by the spring in the lower end of the poppet. Pressure to the top of poppet "A" is from the air reservoir. On the bundler this pressure is about 40 psi. Pilot pressure to the bottom of the poppet from the main supply easily overcomes the low pressure on top of the poppet. With both poppets "A" and "C" up, they are in the power stroke position.

Continued on page 86

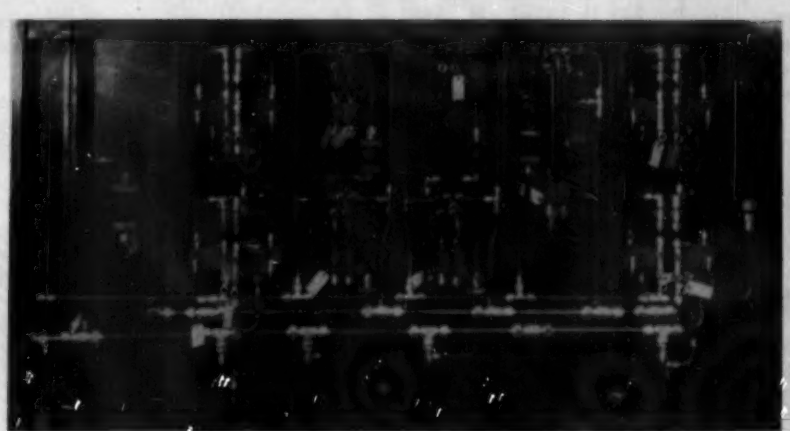
FIG. 5. Schematic of the air saver circuit which makes possible the use of exhaust air from the blank end of the cylinder to power the upstroke.



SECTIONALIZED PANELS
Permit Assembly Line Techniques



FRONT VIEW of a sectionalized hydraulic control panel. Valving and gauges are conveniently grouped.



REAR VIEW shows the piping and valving before being piped to the cylinders and power unit. Ample space is allowed for assembly and maintenance.

WHEN a group of machines having similar but not identical hydraulic circuits is to be built, considerable savings may result if the hydraulic control panels are built in sections.

Separately building the control panel for each machine is a custom job which is costly and may result in panels which are not uniform.

In the design of a group of furnace lines, the engineers at the Surface Combustion Corporation, Toledo, Ohio, arranged the control panels in sections. While the final completed panels for all the furnaces were not identical, each included some of the same sections. Having groups of similar panel sections, permitted applying assembly line techniques up to the point of bolting together sections to form a final panel. Handling individual sections helped reduce panel cost.

Careful circuit layout is required to arrive at a sectional design. The time spent in doing this pays off in the reduced panel cost and in panels which are well laid out for easy assembly and maintenance.

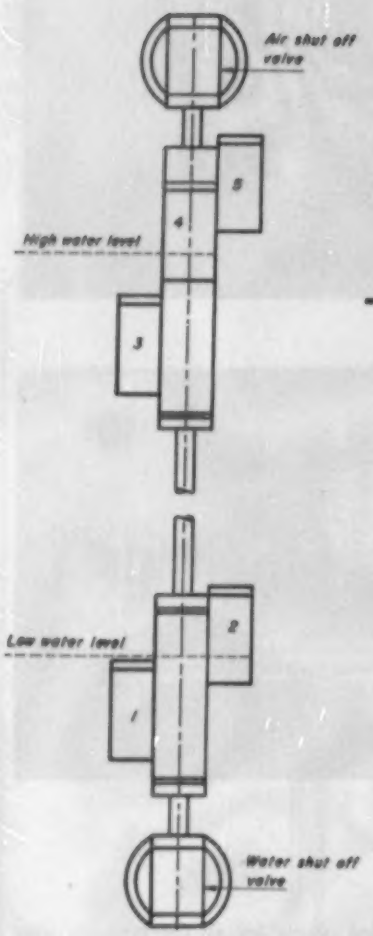
PUMP CONTROL SYSTEM
for large press installation

By C. B. Blake and A. M. Steel
Scovill Manufacturing Company

LARGE water hydraulic systems, using reciprocating plunger pumps and air over water accumulators, require a system to control the water being pumped into the accumulators.

To obtain greater reliability of control, Scovill Manufacturing Company, Waterbury, Conn. has redesigned the control system on their 2750 ton brass extrusion press.

The original control of the accumulator water level on this extrusion



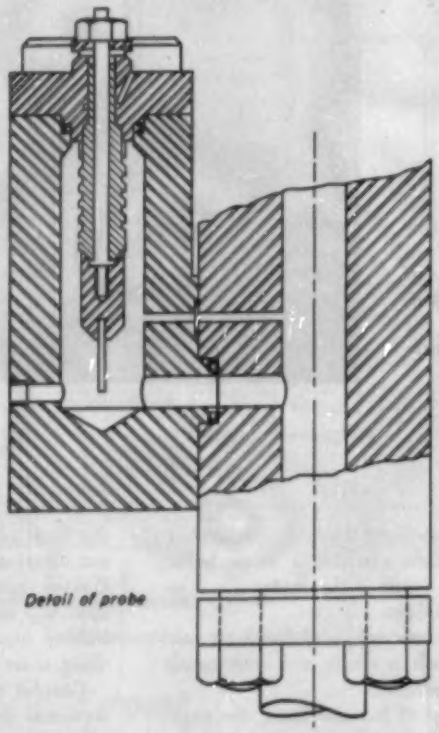


FIG. 1. Five probes are mounted alongside the accumulator. As water level makes contact with each probe, there is an electrical signal which actuates an air valve which controls the pump valve operators.

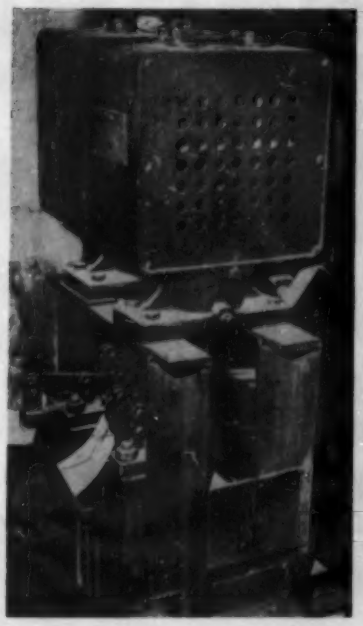


FIG. 2. Old style pump pilot valve operator was a large solenoid which operated the valve by power in one direction only.

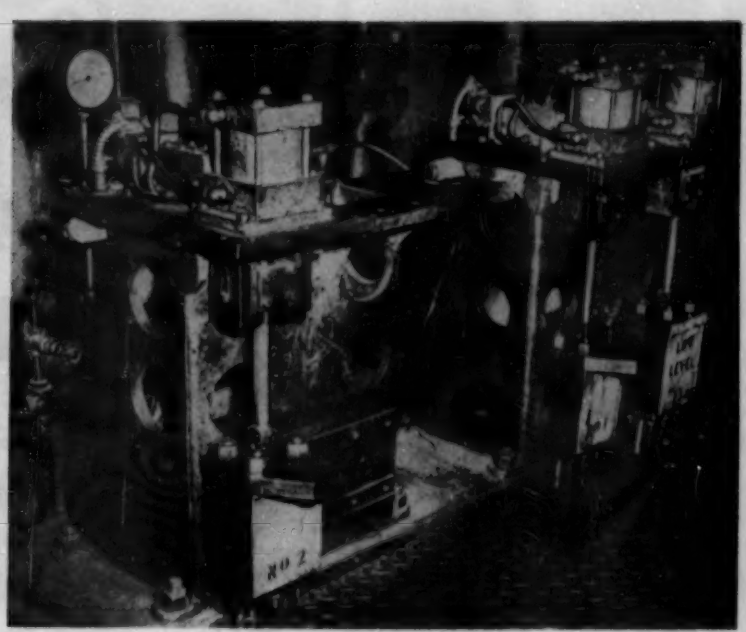


FIG. 3. New valve operators are air powered. Air provides positive action with a minimum amount of maintenance.

press used a long slender aluminum float with an iron core floating in a non magnetic steel tube. Around the tube, at control point levels, were electrical coils, with a constant applied voltage. As the float was raised or lowered with water level, the iron core passed through each coil. Movement through each coil resulted in a small change in current. This small current change operated a very sensitive relay in the coil circuit. The relay, in turn, initiated the proper control. Six coils at various levels controlled the system:

coil 6—no. 2 pump on bypass
5—no. 1 pump on bypass
4—no. 1 pump on pressure
3—no. 2 pump on pressure
2—siren on
1—low level valve closed

The water level was maintained by two 500 hp pumps approximately 160 gpm each at 4250 psi.

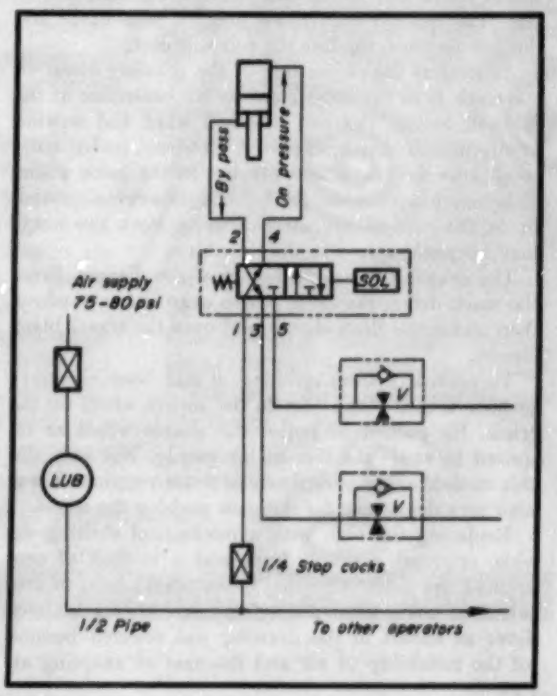
The pumps were run on bypass until the water level dropped to stations 3 and 4 at which time heavy 3 phase solenoids, operating counterweighted 5/8 inch pilot valves, caused the bypass valve to shut and put the pumps on pressure.

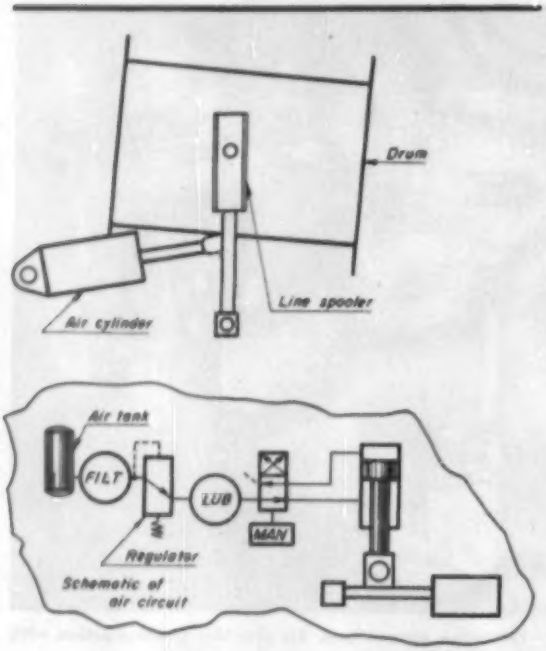
The difficulties encountered made it necessary to keep a pump man in constant attendance. The float riding in the tube with small clearance had a tendency to stick. This was further aggravated by the solenoid action of each coil. The relays were so sensitive that normal mill vibrations caused faulty operation. Voltage variation also was responsible for erratic controls until a voltage regulator was installed.

The heavy solenoid control on the 5/8 inch pilot valves gave positive action in one direction only. The counterweighted return sometimes stuck, holding the pump on pressure. The speed of the solenoid, even

Continued on page 88

FIG. 4. Each of the three valve operators has the same air circuit which is shown here.





LINE SPOOLER is positioned by a clevis mounted air cylinder. Movement is controlled by the 4-way air valve.

Don't Foul the Line!

. . . air cylinder prevents uneven cable reeling on oil well rig

By Peter L. DeMarsh

UNWINDING cable from a drum at varying speeds without fouling the line is the key to successful winch operation. To oil well drillers, rig time is dollars. The quicker the "down hole" trip is made and the job finished, the less the job will cost.

As long as the center line of the winding drum on the truck is in the same plane as the centerline of the oil well casing, the reel line will wind and unwind evenly without any level device. However, under many conditions the centerlines are not in the same plane. This may happen when the truck is on uneven ground, or in the case of off shore drilling work the barge may be pitching.

The drawing shows the layout of the sheaves. From the truck drum, the cable passes over a sheave wheel, then under the floor sheave and over the travel block sheave.

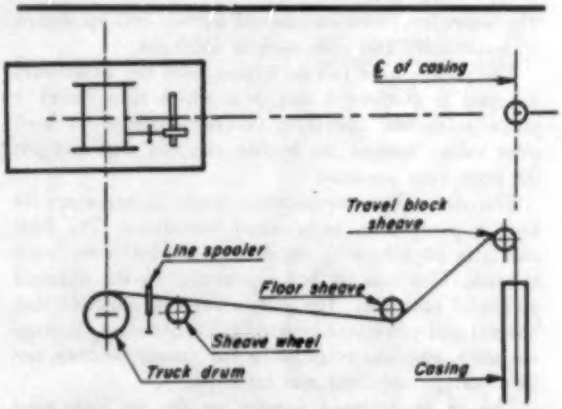
To prevent uneven spooling, it had been necessary to have a man stand next to the sheave wheel on the truck. He pushed or pulled the sheave wheel as required to cause the line to lay evenly. Not only did this method cause slow down in drum rotation, it was also very dangerous for the man pushing the wheel.

Replacing the man with a mechanical shifting device, required a simple lever and a method of controlling the push. Also the device would have to free wheel or coast when not being used. An air actuated lever as shown in the drawing was selected because of the reliability of air and the ease of adapting air to the equipment. Since a 130 psi compressor is standard equipment on perforating trucks, no additional power source was needed.

With this line spooler, it has been possible to spool as fast as 800 fpm when the reel drum is as much as 12 feet off center.

Adjustment of the pressure regulator controls the line spooler. The device has worked well. With the installation of a lubricator-filter, the air circuit has required little maintenance.

LAYOUT of the reeling rig shows the arrangement of the sheaves and the position of the line spooler.



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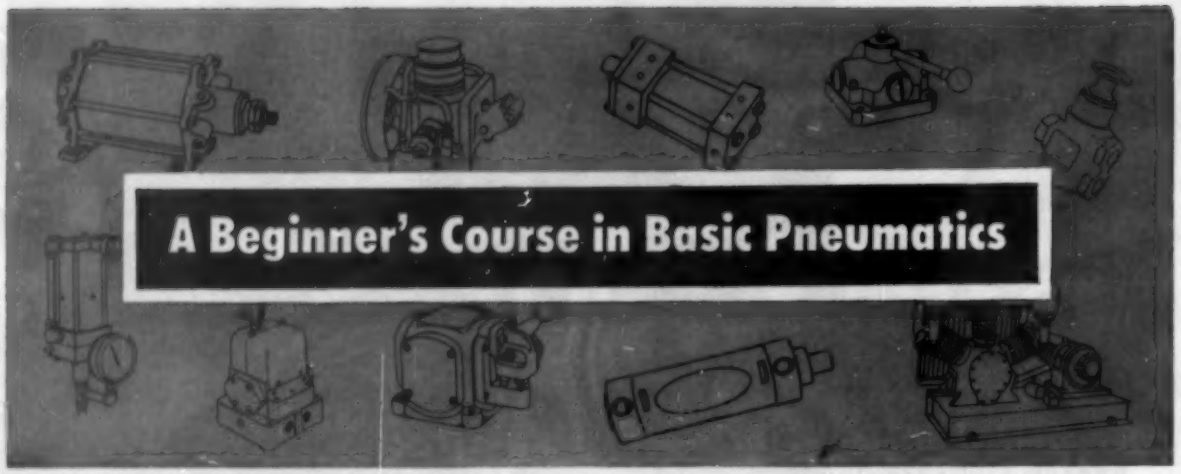


Air Valves

Part 6
Poppet Type Air Valves

THE distinguishing feature of poppet type air control valves is, as the name implies, the poppet principle of opening and closing a passage. Figures 1 and 2 show schematically how poppet control operates. In Figure 1, the poppet is closed and air at system pressure is under the poppet. Note that this pressure under the poppet exerts a force to close and seal the poppet. Figure 2 shows the poppet in the open position, allowing air to pass from the inlet or supply port to the outlet or exhaust port.

Although the diagrams are schematic, the basic principle of operation can be observed. Regardless of how many poppet seals are used to accomplish the required control, they are always installed in such a manner that the pressure of the air being controlled is utilized to assist in "sealing" in the closed position.

The poppet principle embodies some rather distinctive characteristics which make it particularly suitable for air control. Perhaps the most important feature of this type control is the relatively short movement or travel of valve "parts" to obtain sufficient area for air flow. For example, in Figure 2, it can be seen that the poppet has moved only a short distance (a to b) to allow full air flow. This might be further clarified by an example.

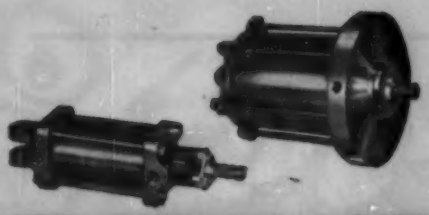
Assume that we wish to open and close a valve on a ⅜ inch pipe line and want to obtain an area through the valve equivalent to the area of the ⅜ inch pipe. We want to accomplish this with a very short movement of any valve parts. The area of a ⅜ inch pipe is .19 square inches. We can use a poppet sealing over a one inch diameter port and require a poppet movemen of only .06 inch to obtain full area.

$$\frac{\text{1 inch diameter} = \text{3.14 inch circumference}}{\frac{\text{.19 square inches area required}}{\text{3.14 in circumference at poppet}} = \text{.06 inch travel}}$$

Of course, a ⅜ inch valve will not have 1 inch diameter poppets as the reasonable and acceptable movement of parts will normally be over the .06 inch travel cited. In case a stem is involved, it would have to be included in the calculations.

Minimum Wearing Surface

Another feature deserves attention. Due to the relatively short travel of any moving parts, the bearing or wearing surfaces and seals are reduced to a minimum. Note, Figure 1, the relatively small stem diameter and the "O" ring seal on the stem. The reduced bearing area of the stem and the relatively small seal plus the short travel means that useful life is extended to a maximum. If, for example, the one inch poppet of our example has a ⅜ inch diameter poppet stem which moves only 1/16 inch for valve action, it is evident that wear will be negligible. Further, the "O" ring



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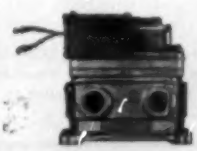

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seal on such an installation could perform almost indefinitely as its entire action would consist of the normal "O" ring roll. At no time would the "O" ring really get a chance to "slide" as it must on long stroke sealing.

Another advantage inherent in poppet operation may be recognized by the above example and explanation. Obviously, the short movement and the reduced area of bearing surfaces permits a poppet type valve to function under what might be termed adverse conditions. When the poppets are faced with a resilient seating surface, as shown in Figure 3, this type of valve can accept considerable dirt, scale and other foreign particles, even though abrasive, and still continue to function satisfactorily. It is never wise to install air operating equipment without provision for adequate lubrication; however, the poppet valve can get along with a minimum of attention.

Maintenance Is Easy

Still another advantage which poppet valves offer as compared to other types is the fact that close fitting parts are not usually necessary; therefore parts replacements may be readily made in the field. This makes maintenance very easy. Repairs to poppet valves do not require special lapping, honing or other precision finishing operations.

We have briefly covered the fundamental principle of poppet operation; in summary, it might be stated that the poppet provides the shortest and fastest means to full area. The poppet principle is used in high speed internal combustion engines for the same reason.

A simple straight-way or 2-way valve uses a single poppet, as shown in Figure 1. A 3-way valve has two poppets, as shown in Figure 4, while a 4-way valve will have four poppet seats. These diagrams are schematic to show the individual poppets in relation to the direction of air flow. It will be noted that, when closed, each poppet is held in the sealing position by air pressure. For example, in Figure 4, when pressure is admitted to the cylinder, exhaust poppet "b" is closed and pressure in the cylinder is helping to close and seal the escape to exhaust. When the valve is reversed to exhaust the cylinder, poppet "a" closes before "b" opens, and again air pressure is assisting in the job of sealing since full system pressure is under the closed poppet "a".

To obtain simplicity and to keep wearing or sealing surfaces and areas at a minimum, poppet type air valves are unbalanced. Figure 5 is a sketch of a balanced type valve in which pressure within the valve is acting on equal areas in each direction. It can be seen that the relative travel must be greater and that the sealing circumference must also be relatively greater on this type of valve than on a poppet type valve.

It might be pointed out that in direct acting poppet valves where an operating lever acts directly on the poppet stems, the unbalanced feature must be recognized in the design of the operating lever or mechanism. The force required to open the poppet is related to the air pressure and the unbalanced poppet area.

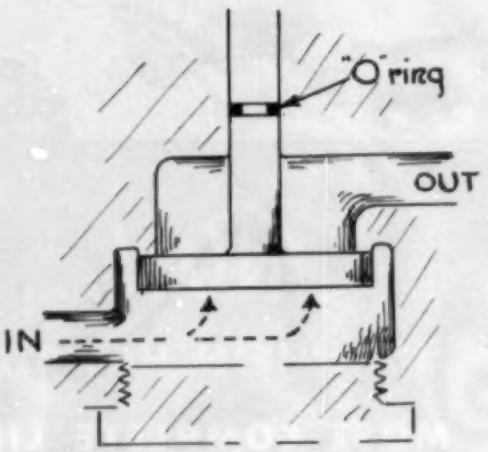

FIG. 1. BASIC straight-way or 2-way poppet type air valve in the closed position. Air pressure closes and helps seal the poppet.

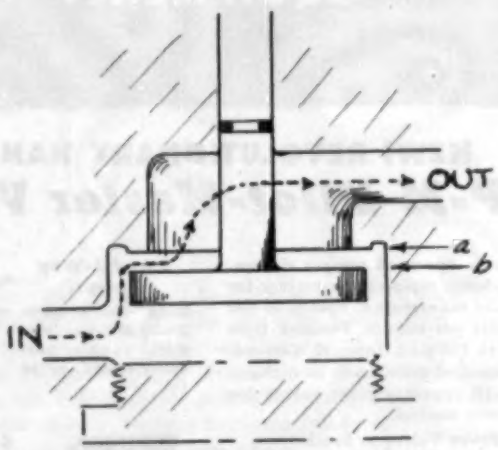

FIG. 2. POPPET type air valve in the open position. The poppet head in the open position allows air to pass from inlet to outlet ports.

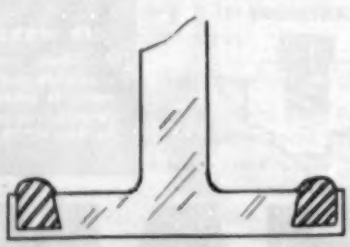

FIG. 3. WHEN THE seating surface of a poppet is provided with an insert resilient face, the poppet can operate for indefinite periods in spite of considerable contamination in the system air.

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Poppet Type Air Valves

On some of the earlier models of poppet valves, especially in the larger sizes, it required a considerable mechanical force to "break" the poppets against air pressure.

Modern valves utilize all of the inherent advantages of the poppet principle, i.e., unbalance for tight sealing and short travel of relatively light valve parts. At the same time such modern valves completely overcome any of the actual or theoretical operation shortcomings of the early valves.

Figure 6 diagrams the modern 3-way normally closed poppet valve. This arrangement performs the same function as the 2-poppet, 3-way valve shown in Figure 4. In construction, however, both poppet seats are operated by a single stem. The pilot piston which operates the assembly has an area greater than the poppet area, so that again air pressure assists in sealing both supply and exhaust poppets to their closed position.

Figure 7 shows another pilot piston operated 3-way valve, but this is a normally open type.

These pilot piston operated poppet valves take full advantage of the principle described above; such valves may be operated at extremely high speeds. Also they provide a means whereby many control variations can be obtained simply with the same basic valve elements.

Acknowledgement: We are indebted to Elmer F. Heiser of S. G. Morris, Cleveland and to the Ross Operating Valve Company in the preparation of this installment.

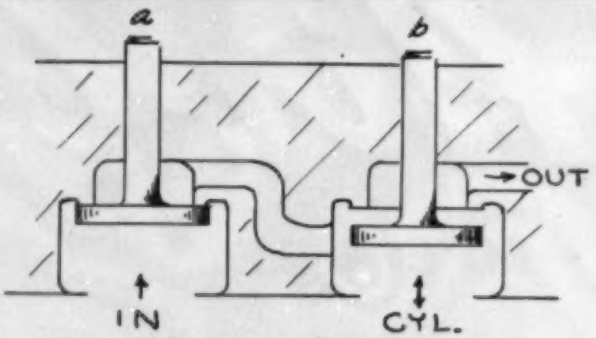


FIG. 4 IN THIS 3-way valve two poppets open and close alternately. The illustration shows the cylinder poppet open, exhausting the air while the inlet poppet is held closed under pressure. When the valve is reversed, the inlet poppet is open and the outlet (exhaust) poppet is held closed.

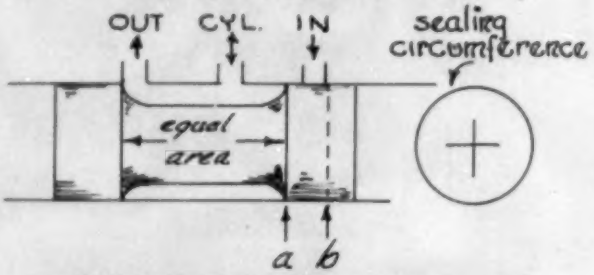


FIG. 5 SINCE PRESSURE in a piston or spool type valve is balanced, the spool must travel farther and the sealing circumference must be greater than in a poppet valve to accomplish the same result.

FIG. 6. A TYPICAL 3-way normally closed poppet valve as shown, performs the same function as the two poppet 3-way valve shown in Figure 4. However, here both poppet seats are operated by a single stem. A pilot piston of greater area than the poppets operates the assembly, insuring that air pressure aids in sealing supply and exhaust poppets in their closed positions.

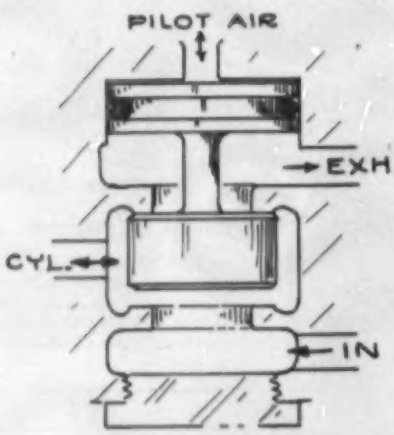
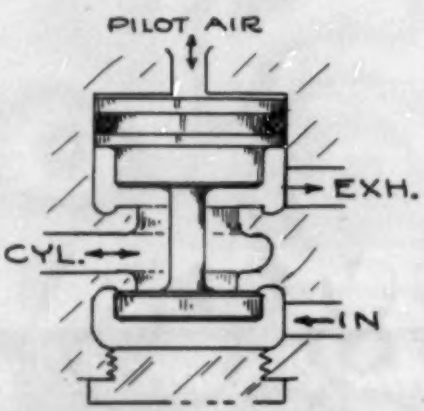


FIG. 7. ANOTHER pilot piston operated 3-way valve, in this case a normally open type.



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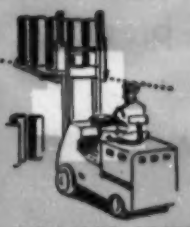

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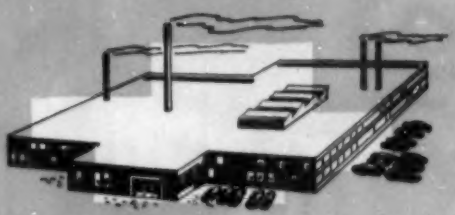

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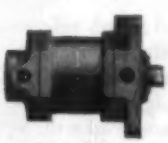

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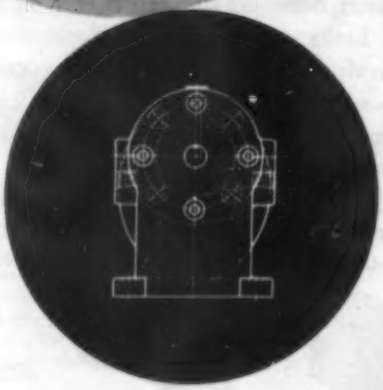

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Hydraulic Servo Mechanism

Concluded from page 65

where the pump must operate in any mounting position, a lightly pressurized reservoir is necessary in order that the intakes of the control and replenishing pumps will be supplied with oil at all times. In some instances the sump has been designed as a part of the servo pump unit package.

(4) *Electric motor.* For driving the pump. The electric motor can be furnished mounted directly to the pump unit.

(5) *Hydraulic motor.* For converting the oil pressure and flow from the pump into mechanical energy to drive the load.

(6) *Synchro or voltage generator at the hydraulic motor or load.* For supplying the "overall" feedback signal from the hydraulic motor output (this closes the "major" loop). Opportunity is provided here for the inclusion of such compensating networks as may be advantageous. The output from this major loop feedback is usually put into the amplifier which controls the servo pump solenoid.

(7) *"Dither".* A dither, or small, high-frequency oscillation, is usually imposed on the electrical signal by an oscillator circuit incorporated in the amplifier used to control the pump unit. The purpose of this dither is to overcome static friction in the pump unit, make centering and reversal control sharper, and generally reduce the effects of tolerances and leakage. It also appears to cause some reduction of the electrical hysteresis effect in the solenoid in some cases.

Power and life ratings for the servo transmissions depend upon a variety of conditions, and should be checked for each specific application.

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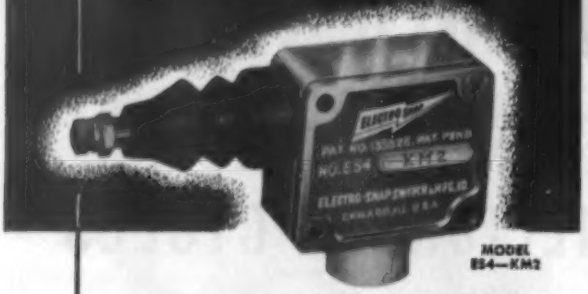

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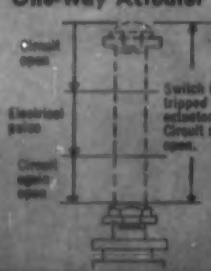

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Want Faster Operation? Use Air Circuits

Concluded from page 72

When "A" and "C" are first raised, poppet "B" is being held closed by the spring at the top. It opens to close off the exhaust port, when high pressure air going to the top of the cylinder also goes to the bottom of poppet "B".

When the sequence valve is closed to initiate the upstroke, poppets "A" and "C" have dropped and air to return the cylinder is supplied from the air reservoir. At this moment, air pressure from the top of the cylinder holds poppet "B" up. Air expelled from the top of the cylinder passes back through the air saver valve around poppet "C", over raised poppet "B" and lowered poppet "A" and into the air tank. Also, this compressed air from the blank end of the cylinder passes through the bottom port of the air saver valve and passes to the rod end of the cylinder. At this point, the cylinder piston is in the lower dotted position. As long as air pressure above the piston head is greater than air pressure below the piston and in the tank, air continues to flow through "B" poppet and maintains a differential pressure across the poppet, holding it open. The pressure differential decreases progressively and after a short time interval, governed by the spring setting above the "B" poppet, the spring overcomes the pressure differential and forces the poppet down. When poppet "B" drops, it stops flow of air to the air tank, and opens the top end of the cylinder to the exhaust port. Air pressure from the air tank can now raise the main cylinder.

Regulating the Air

A pressure reducing valve in the air supply line to the air reservoir is set at slightly less than the 40 psi tank pressure. It is used to fill the tank from the high pressure line for initial return stroke and to makeup for air leakage during long idle periods. Otherwise it is not used.

When using the air saver valve on the bundler, there is almost enough air recovered from the operating stroke to return the cylinder to the normal position. Adjustment of the spring over poppet "B" allows more or less air to be saved. If maximum speed is required, increasing compression of the spring will cause the "B" poppet to lower at a higher pressure difference and therefore less air will be recovered, but the top of the cylinder piston will be exhausted more rapidly and the cylinder returned sooner.

On the bundler, all these operations happen fast since up to 24 bundles can be single wired tied each minute. To keep the circuit operating smoothly two air lubricators are in the circuit. The oilers are automatic. One oiler handles all air for the low volume auxiliary cylinders; the other oils the air for the high volume main cylinder. This premits separate lubrication adjustments of the two systems to balance the oil to the lubrication requirements.

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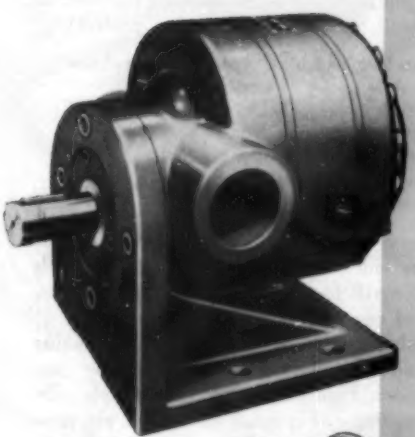

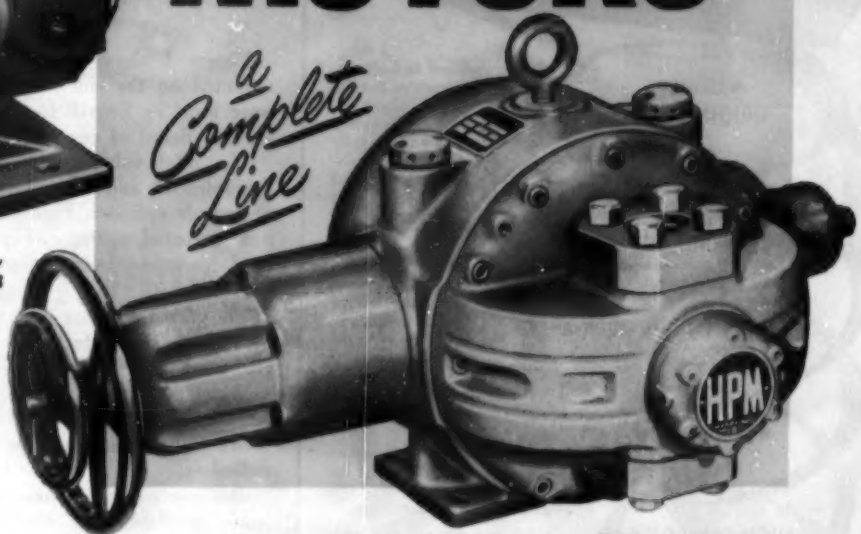

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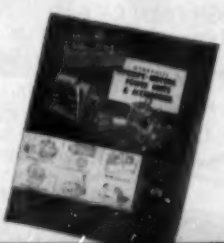

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Pump Control System for Large Presses

Continued from page 75

though controlled somewhat by an air dashpot, resulted in heavy line shock every time the pumps were put on pressure.

To eliminate the float and control problem, a floatless control was selected. This consists essentially of prod making contact with and completing an electrical circuit through the water in the accumulator. It was also decided to put both pumps on pressure together to simplify the circuit. This gives a 5 station control:

station 5—puts both pumps on bypass and blows horn to show failure of station 4
4—puts both pumps on bypass
3—puts both pumps on pressure
2—starts siren (indicates low water)
1—shuts low level valve (prevents high pressure air flow into press circuit)

Figure 1 shows the layout of the control prods mounted on the side of the accumulator. The prods were built by Scovill to withstand the 4250 psi pressure. A detail of one of the prods is shown.

The pilot valve operators were rebuilt, replacing the solenoid and loose linkage with a directly connected air cylinder. Figure 2 shows the old style solenoid actuated operator. Figure 3 shows the air powered operators, and Figure 4 is the air circuit for the operators.

The new operators give positive operation in both directions, eliminate all loose linkage with its resulting wear and lost motion. Speed control of the air cylinder puts the pumps on pressure with no perceptible line shock. This unit has been in service over 4 years without maintenance or failure of air valves or cylinders.

Because of these changes, a pump man has been made available for other duties, and more reliable operation of the accumulator and pumping system has resulted.

1954 Prize Paper Contest

The 1954 Prize Paper Contest is open to every reader of APPLIED HYDRAULICS. This year contestants will have the advantage of checking their entries against last year's top entries. A number of the prize winning and honorable mention papers have already been published (October, November and December issues).

The judges for the 1954 Prize Paper Contest are named on page 52. In evaluating entries, greater emphasis will be placed on practical, dollar saving ideas than on presentation. Last year five of the seven cash prizes were won by design and production men. Awards of the first three major prizes were made last year at the National Conference on Industrial Hydraulics.

Write today for your Entry Blank, Rules of the Contest and Suggestions to Contestants.

The Contest closes on June 1, 1954.

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The "O" Ring Spiral Failure Problem

What are the causes of failure?

How can they be corrected?

Although AN standard "O" ring seals have been satisfactorily used for several years in most landing gear shock struts, certain installations have been prone to spiral failures. The design features which result in these failures have never been fully explained. It is known that many variables are involved.

SAE Committee A-12, Aircraft Shock Struts, through a sub-committee headed by R. C. McQuire, Development Engineer, Structures, American Airlines, Inc., has studied the problem. This was done by a survey of the opinion and experience of the industry. Cooperating in the survey were members of SAE A-12, SAE A-6, Navy Bureau of Aeronautics, Wright Air Development Center and Air Transport Association. Opinions were expressed by representatives of the leading airframe manufacturers, airlines, "O" ring manufacturers and shock strut manufacturers. The results and general conclusions of the survey are outlined below.

The sub-committee in their report emphasized that the information to date is by no means conclusive, that it is a summary of the case histories of spiral failures submitted by a number of airframe manufacturers and airline operators and is primarily a series of check lists of conditions under which spiral failures have occurred and the corrective actions taken to eliminate them. The investigation is continuing.

Types of Failures

Two types of failures of standard AN "O" ring installations have been reported after a short period when used as rod seals. These types are *extrusion nibbling* and *spiraling*.

Extrusion nibbling is believed to be the result of clearance changes at one or more portions of the ring. Extrusion nibbling failures were fairly prevalent when the "O" ring packing was first introduced. The failures were corrected by installing leather back-up rings on one side of the seal. Recent experience with certain nonflammable fluid installations requiring the use of butyl polymer seals has resulted in the development of Teflon back-up rings. Teflon rings have generally been superior to leather rings, both in mineral oils and in nonflammable fluids.

. . . it's headed your way.

Fighters who've been socked by Rocky Marciano have probably suspected for a long time that they've been hit by an air hammer. They've had good reason, because a recent test showed that Rocky's punch packs about a 925 foot-pound wallop. Rocky has to hit hard. But pneumatics can be gentle as a breeze or strong as a cyclone, depending on the job to be done.

Engineers all over America are keeping their eyes on new applications of an exciting force. By its earlier use in gun chargers, emergency power actuation and other utility power applications, pneumatics has shown its vast potentialities in the field of aviation. It may well be *the* actuating power of the future.

Pneumatic systems for aircraft offer tremendous advantages. They are light, simple and safe. The use of air insures an unlimited supply for the system, and eliminates the fire hazard. Pneumatic systems operate over a wide temperature range with an exceptionally high energy delivery . . . can operate huge loads quickly and easily.

We here at Kidde foresee a great future for pneumatics, and have been fortunate in being in on the ground floor of this fascinating field. Perhaps, like ourselves, you too are interested in this new application of a well-known energy source. If you have a problem in pneumatics write us.

Kidde

Walter Kidde & Company, Inc.
316 Main St., Belleville 9, N. J.
Walter Kidde & Company, Ltd., Montreal, P. Q.

Spiral failure of AN "O" ring seals in landing gear shock struts has been a persistent, unpredictable problem. A considerable body of data, collected by SAE A-12 Committee, surveying case histories of airframe and airline companies is summarized in a recent Aeronautical Information Report (No. 36, Oct. 15, 1953.)

Spiraling is caused by twisting of the seal during the motion of the piston. The exact dynamic behavior of a rod seal under various conditions of stroke speed, squeeze, side load, etc. is not known. It is reasonably certain that the ring slides and rolls. It obviously slides under high pressure when the ring is intentionally deformed. It rolls when the ring is under low pressure and the friction conditions are such as to "gear" the ring to the piston but not restrict it in the groove.

Probable Causes of Spiral Failure

The conditions which cause spiral failure are obviously those which cause segments of the ring to slide and others to roll simultaneously. Such conditions can only be induced by differential friction forces on the ring. Friction force is a function of normal load, coefficient of friction and area. Any condition in a seal installation that effects the working balance of any of the variables probably results in spiral failure.

For example, if side loads materially reduce the clearance between the piston and adaptor, the squeeze on the "O" ring (or normal force parallel to the radius) is increased. This also results in an unbalanced area of seal contact. Similarly, if the piston plating is worn to the base metal at one point on the circumference, the coefficient of friction at that point will be changed.

If the conditions which affect friction between the "O" ring and associated surfaces are classified in terms of "normal force", "coefficient of static, sliding and/or rolling friction" and "area", the breakdown is as follows:

1. Conditions which effect the normal load on the seal are:

(a) "O" ring squeeze
(b) "O" ring stretch (circumference of piston vs internal circumference of the "O" ring)
(c) Concentricity of piston, adaptor and cylinder, e.g., annular clearances
(d) Manufacturing tolerances of the "O" ring, cylinder, adaptor and piston
(e) Other effects on such tolerances, such as temperature, seal swell, chemical action of oils, etc.
(f) Side load on piston vs clearance dimensions between piston, adaptor and cylinder. (Note: Increased clearance between adaptor and cylinder provides a floating action which probably tends to relieve unbalanced radial forces on the rod seal.)
(g) Deflections of the piston, cylinder and adaptor under load, e.g., breathing of the outer cylinder
(h) Air pressure in the strut—extended vs compressed
(i) Durometer hardness of the ring as related to stretch
(j) Shape and design of groove
(k) Poorly installed rings. Twisted rings cause local high pressure points.

2. Conditions which effect static, sliding and rolling coefficients are:

(a) "O" ring compound
(b) "O" ring hardness
(c) Lubrication
(d) Speed of stroke
(e) Quality of surface finish of rod, groove and seal
(f) Type of plating used on metal parts
(g) Effect of temperature on surface conditions, lubrication, etc.
(h) Type of lubrication (chemistry, volatility, tackiness of oil)
(i) Contaminants
(j) Dimensions and material of back-up

3. Conditions which effect the contact area of the seal are:

(a) Air pressure in the strut
(b) Hardness of ring material
(c) "O" ring squeeze
(d) Support provided to "O" ring by stiffness of back-up on low pressure side
(e) "O" ring stretch
(f) "O" ring installation procedure—a twisted ring will not deform uniformly under pressure
(g) Shape of groove (angle or square)
(h) Dimensions of groove (wide or narrow. Narrow results in side squeeze)
(i) Flash or flat spots on "O" ring
(j) Stress aging of the "O" ring
(k) Side load—non-uniform squeeze causes non-uniform deflection
(l) Surge pressures, vibration (variable area during stroke).

4. Other conditions that can accelerate or induce spiral failure are those that tend to weaken the ring structurally such as:

(a) Large D/d ratios
(b) Surface cracks on "O" rings
(c) Improper cure of "O" rings
(d) Nibbling

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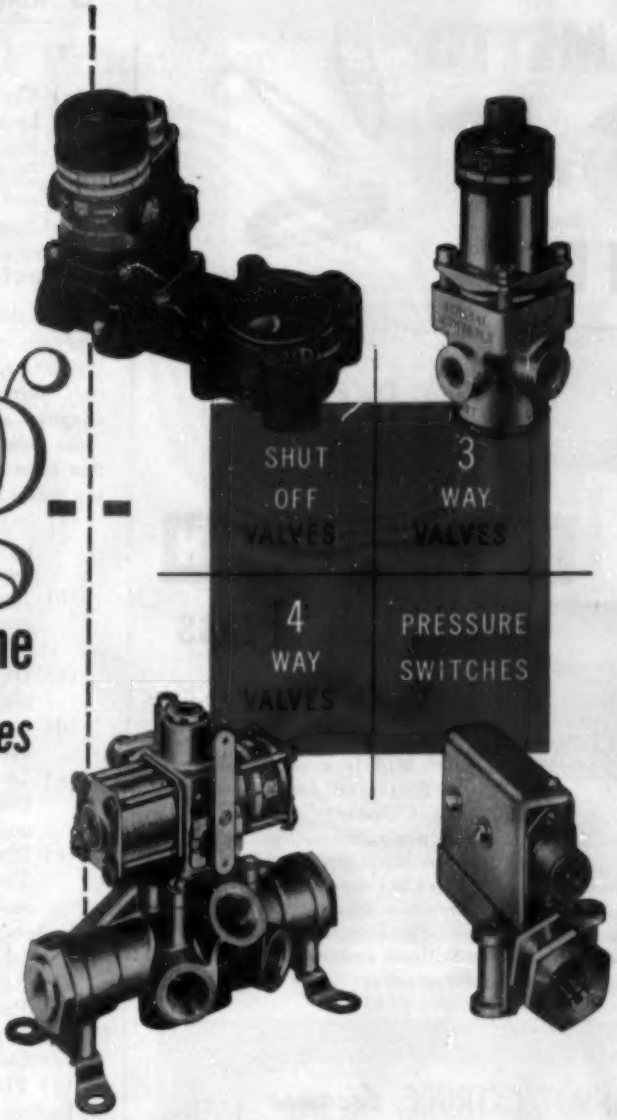
that rolls, floats, or flies



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In engineering terms "high g" means high gravitation forces. In performance terms "Hi-g" means General Controls' reliable line of automatic pressure, temperature, level and flow controls for heavy duty under acceleration factors from 10 to 300G. The Hi-g line comprises electromagnetic pilot and shutoff valves . . . manual and motor-driven gate valves . . . electrohydraulic selector valves . . . gauge and differential type limit controls . . . all light in weight, compact in design and trustworthy in operation . . . handling a great variety of liquids and gases in a wide temperature range.

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Perfect for the
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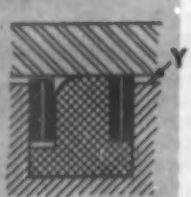
Widely used Watson-Stillman Laboratory Presses, with capacities from 10 to 100 tons, operate at a maximum pressure of 6,050 psi. Conventional packings, because of extrusion had to be replaced in 4 to 7 days; the G-T Ring, in the same application—as a dynamic ram seal—lasted from 3 to 4 months without extruding!

That's why Watson-Stillman switched to the G-T Ring—and switched for good!

CANNOT EXTRUDE, *because*



As pressure is applied, conventional packings soon extrude into clearance space Y, then fail. Not so the G-T Ring! Because of its design consisting of a resilient sealing ring in a T-Section supported on each side by two non-extrusion rings, it cannot extrude. As pressure is applied to the G-T Ring, the resilient material flows under the non-extrusion rings, urging them against the cylinder wall and blocking the path of extrusion.

In pressure applications, dynamic or static—pick Palmetto G-T Ring—the packing designed expressly for non-extrusion.

Write for our Manual MP-200, Engineering Standards for Palmetto Molded Packings. For design information on G-T Rings, see our catalog in Sweet's Product Design File.

PALMETTO Packings

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"O" Ring Spiral Failure

Continued

(e) Sharp edges on cupped and hardened leather back-up rings
(f) Sharp edges on groove corners
(g) Stress aging due to high ambient temperatures and load
(h) Score marks on piston

Corrective Action

Since the susceptibility of a strut to spiral failure is generally exposed during design or qualification testing, action to eliminate the trouble is usually directed only toward improving the relationship of seals, adaptors and piston.

As indicated for the aforementioned survey, factors that have been most successful in avoiding or correcting spiral failures in shock struts are:

(a) Improved lubrication by manually greasing before assembly, wick action of back-ups, lubricated felt wipers, etc.
(b) Improved assembly technique and copious grease lubricating of ring, cylinder and piston. Oil may not be adequate.
(c) High extended air pressure and small diameter pistons
(d) Improved manufacturing control of clearances and concentricity
(e) Low "O" ring squeeze with improved adaptor float. (Increased clearance between cylinder and adaptor only)
(f) Rings other than round such as the Delta ring. The Delta ring is resistant to twist but is more susceptible to wear.

Factors which have been least succesful in correcting spiral failures are:

(a) Roughened grooves
(b) Paraffin and graphite impregnated rings
(c) Superfine surface finish on piston and grooves
(d) Double leather back-ups on low pressure side
(e) Plating other than hard chrome.

Factors which have been successful in some applications but not in others are:

(a) Angle grooves (15-45 degrees). These increase wear and abuse of packing
(b) Low squeeze (.020 max.) with floating adaptor
(c) Felt wiper lubrication
(d) Chamfering of groove edges and relief (.004-.006 of groove edges (when extrusion nibbling is present).

Struts subject to spiral failure difficulties should be very carefully analyzed in terms of the above criteria. Corrective action can then be directed toward making the ring more resistant to twirl by adjusting a basic variable in the friction equation, e.g., normal load, friction coefficient or area.

The investigation of causes of and corrective measures for spiral failures in shock struts is being continued by Committee A-12. Information on shock strut spiral failure experiences will be appreciated by the Committee. Send data to S.A.E. 29 W. 39th St., New York 18, N. Y., attention William Beckerle.

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Rhodes Lewis Company, a wholly-owned subsidiary of McCulloch Motors Corporation of Los Angeles, designs and produces specialized types of precision-made pneumatic and electro-mechanical accessories for the military and for aircraft industries throughout the world.

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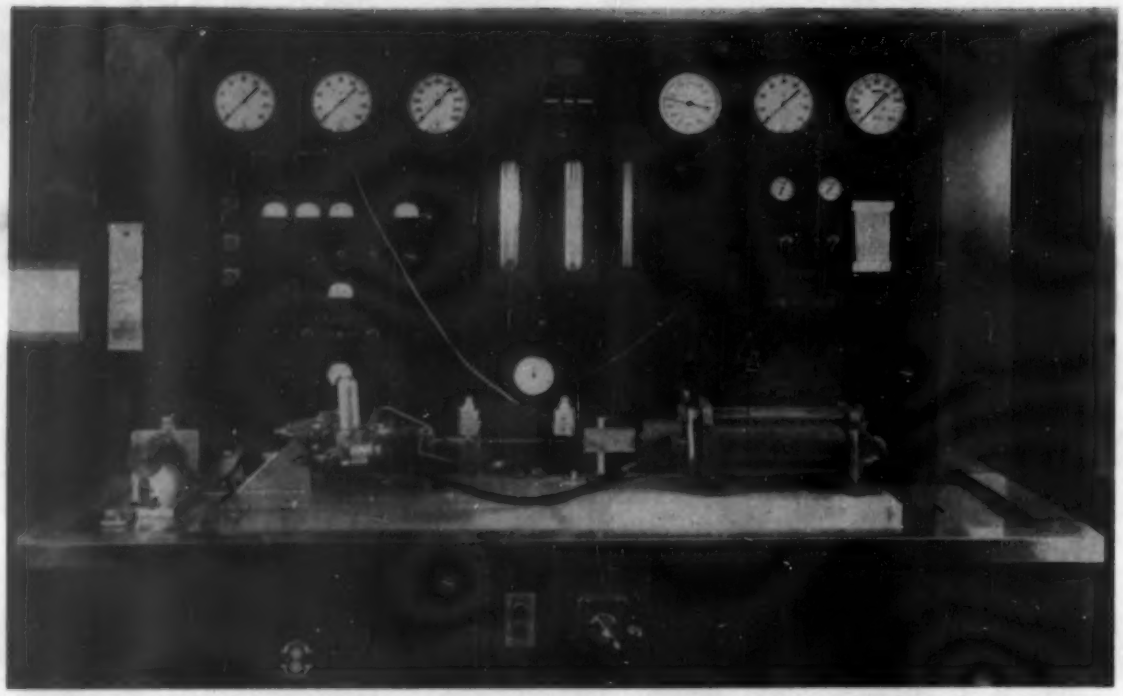

HYDRAULIC TEST installation. Exhaust nozzle control is mounted on the left; loading cylinder is on the right. Test duplicates conditions during jet engine operation.

HYDRAULIC TEST CIRCUIT for jet aircraft exhaust nozzle actuation

By Andrew J. Auld, Jr.

ONE of the primary requisites of a high speed turbo-jet engine is that optimum thrust must be obtained under a variety of operating conditions while at the same time specific fuel consumption must be held to a minimum. One of the approaches to the attainment of such an ideal set of engine operating conditions has been the introduction of a variable area exhaust nozzle which varies the thrust much in the same manner as the nozzle in a garden hose varies the flow of water.

The Westinghouse turbo-jet engines use several types of exhaust nozzle controls to accomplish the movement of the variable area nozzles. A hydraulic circuit used to production test and calibrate these exhaust nozzle actuators has proven satisfactory and virtually trouble-free. In addition to being used as a production test facility, the apparatus has been used extensively as a checking facility to determine cause of control malfunctions and corrective actions necessary.

ANDREW J. AULD, Jr., Design Engineer, Westinghouse Electric Corporation, Aviation Gas Turbine Division, South Philadelphia, Pa.

Electro-mechanical Servo Control

The exhaust nozzle control is an electro-mechanical servo-mechanism which receives its operating signals through an electro-positioning device that is connected through linkage to the pilot's throttle. The operation

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SILASTIC *stays elastic*

Even after prolonged exposure to sun and weather!

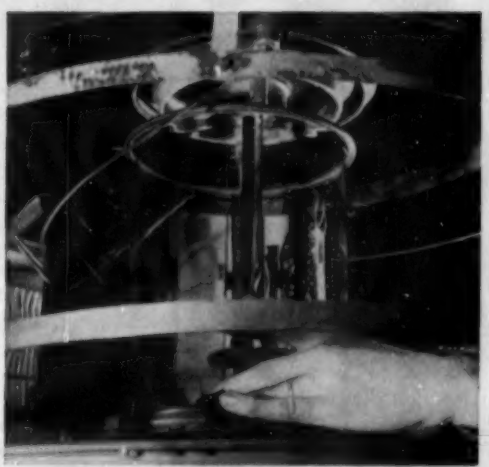
Here's an application in which Silastic,* the Dow Corning silicone rubber, is used to seal a pseudo sun. Core of an instrument used in textile laboratories to test the light fastness of fabrics is a carbon arc enclosed in a glass chimney. The glass chimney is designed to exclude air and to filter out of the arc light any wave lengths not found in sunlight. Air around the arc makes electrodes burn faster and give off smoke that clouds the glass.

But despite a tight glass to metal seal, air leaks in. Operators found that the chimney had to be cleaned every day and replaced whenever bits of glass were chipped off by the shock of the arc making and breaking. Finally, a bright chemist who didn't like to wash dishes solved those problems by using a Silastic seal between the chimney and the metal plates.

The Silastic seal stays resilient for 6 to 12 months in spite of the heat of a carbon arc less than 6 inches away, and exposure to the whole spectrum of light given off by the arc. And that's no more than long term outdoor exposure in test stations would lead you to expect. Typical samples of Silastic exposed under stress show no sign of cracking, and hardness is increased by only about 10 points after more than 4 years of exposure.

That's why it pays to try Silastic first whenever you need a material that stays rubbery and retains good dielectric properties at high or low temperatures, after long exposure to weathering or many years of service under normal conditions.

*T. M. REG. U. S. PAT. OFF.



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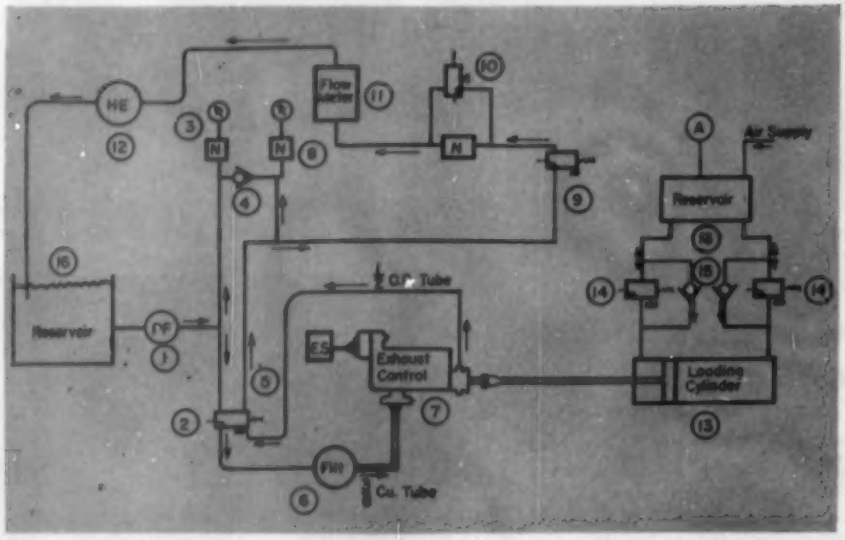


HYDRAULIC circuit for production testing exhaust nozzle actuators.

of the control is closely coordinated with the fuel system and control to permit attainment of optimum thrust conditions. Position feedback is accomplished by means of a helix-operated potentiometer mounted within the control piston.

Testing of the controls is done on a hydraulic test stand designed to duplicate as closely as possible the conditions encountered during actual engine operation.

Reference to the circuit diagram shows that oil is drawn from the reservoir by a 3 gpm, 1500 psi, fixed displacement pump (1) that is similar to the engine-driven pump normally used. The oil is then directed toward the 1500 psi relief valve. (2), which serves as a safeguard against excessive pressures in the event of clogging of the actuator or other obstruction of flow. Pressures as read on gage (3) are the operating pressures supplied to the control. The check valve (4) is of the controllable type and is normally closed. Oil that is by-passed through the relief valve (2) is directed into line (5), which is normally at 150 psi pressure. During engine operation this line supplies an engine bearing.

The oil passes through a 10-micron filter (6) and into the control (7) at a maximum pressure of 1500 psi. Normal operating pressures are approximately 300 to 400 psi so that the pump operates under very lightly loaded conditions most of the time. After the oil passes through the control, it is discharged at a pressure of about 150 psi, which simulates bearing lube pressure (as read on gage 8). This pressure is maintained by relief valve (9). Relief valve (10), which is normally bypassed, is set at 300 psi and is used to pressure test the low pressure sections of the actuator housing. The oil then passes through a flowmeter (11) and a heat exchanger (12) and is returned to the reservoir. The heat exchanger maintains the oil at an average engine operating temperature.

The control is so designed that in the event of a line or pump failure, a pair of hydraulic locks will close and hold the control piston in its position at the time of failure. To test these locks, valve (4) is opened, thus diverting flow that would normally go to the exhaust nozzle control. Thus deprived of its operating fluid, the control loses internal pressure and the hydraulic locks close. To simulate external loading on the piston a hydraulic loading system is employed.

This hydraulic loading system is comprised of a loading cylinder (13), two relief valves (14), two check valves (15), and a pressurized reservoir (16). This system can be used to stimulate gas and friction loads during operation or as a "dead" load during testing of the hydraulic locks.

This test equipment has proven versatile also for other types of testing and as evidence of its practicability has been installed in several locations where controls are serviced and repaired.

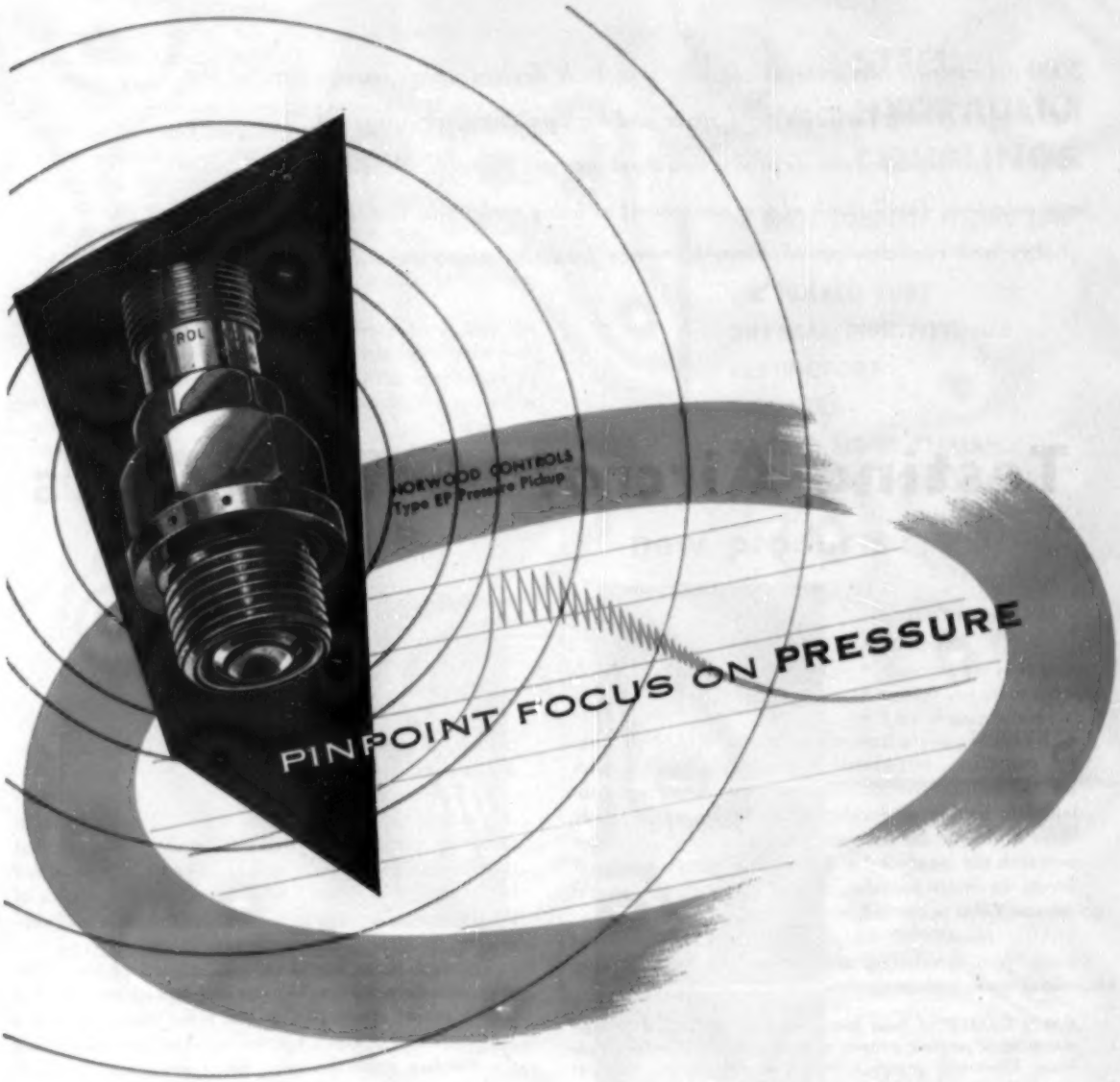
Air Pumps and Accessories

A short introduction to air and low vacuum pumps, "Air at Medium Pressure and Vacuum, Equipment and Data" by Ormonde Bogert, just published, is an excellent first book for the layman and beginner. The short, basic treatment of types of air pumps, pump accessories, pressure and vacuum gauges is concise and well presented.

Twelve types of air pumps are described and illustrated. Other sections are devoted to the flow of air and its measurements and to pump accessories.

A list of 35 typical vacuum applications, a glossary of air terms, abbreviations, air formulas and 16 basic tables make the 60-page, paper cover booklet a very useful introduction to low vacuum equipment.

Copies of the booklet priced at $1.00, may be obtained from Mr. Bogert, 166 Christie St., Newark 5, N. J.



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Full Scale Pressures — 500, 1,000, 2,000, 3,000, 5,000, 10,000 psi . . . response down to 0 psi absolute with 1% of full scale accuracy and temperature compensation.

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A word about NORWOOD CONTROLS—*This name stands for an expanding line of commercial instruments for the measurement of pressure, flow, temperature and weight. It represents a fresh concept of creative engineering which, combined with New England manufacturing skill, is establishing new frontiers in the field of instrumentation.*

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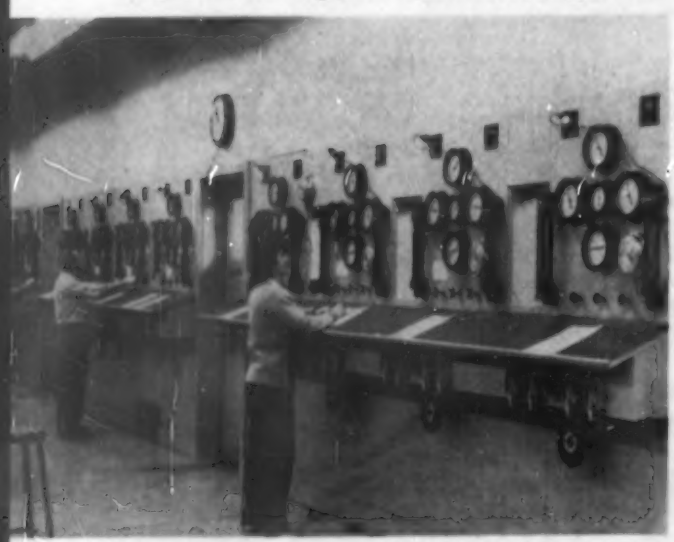
3000 psi aircraft compressors are precision built devices which require careful testing. Proper testing facilities need space and high performance equipment. This equipment is often as expensive as production machines and requires the same care in design and selection. Don't think of test equipment as being non-productive. It isn't. It assures quality and customer satisfaction. Here are facilities which were designed for . . .

Testing Aircraft Compressors

SEVERAL years ago when Walter Kidde & Company, Inc., introduced its pneumatic gun chargers for .50 calibre aircraft machine guns, it did not contemplate having to develop air compressors to power them. However, the company's work on the gun charger revealed the need for a 4-stage air compressor that would be both lightweight and compact, yet would deliver 3,000 psi at sea level.

After months of design work, additional months were spent developing and testing the best working models. Only then could plans for scheduling and production be made.

EACH GROUP of four test panels is supervised by one operator. Pressure gauges record individual stage readings. Electrical pressure switches shut down the test stand if excessive pressure occurs in any stage.



V. J. Hill, vice-president in charge of manufacturing, states that when his division considered the manufacturing and testing procedures for the unit, it realized that the noise of testing would have to be minimized in the assembly space. The technical characteristics of the compressor required that assembly be accomplished in ideal atmospheric conditions.

To meet these specifications, a part of the plant approximately 160′ x 55′ was segregated and divided into a major space (40′ x 160′) for assembly and a long hall (15′ x 160′) for testing. The wall separating the test hall from the work room was sound proofed, and the ceiling of the assembly room was covered with noise absorbent material.

Problems of achieving proper control of temperature and humidity were overcome by air conditioning the assembly room and dust removal of incoming air was accomplished by an electrical precipitation process. The atmospheric conditions in the test hall were not as important as those in the assembly room so it was equipped with only puller and pusher fans which effect a complete air change every one and one half minutes.

Finally, after a flow study was completed, a semi-assembly line for the work room was set up.

Equally important were the elaborate preparations made for testing the compressors. To accomplish this work, twenty-eight batteries of test stands were required. The inspection-recording desks of each stand are in the assembly room while the compressors and associated equipment are in the test hall.

A control panel on the inspection-recording side of each stand contains pressure gauges for each stage of the compression cycle. Also on the panel is an oil pressure gauge, a flow meter for air output, and a flow

meter for "blow by" air which leaks past the pistons into the crankcase.

When testing, a green light on the panel indicates that the compressor is running smoothly. If any stage exceeds its rated pressure, or if oil pressure drops below a preset point, testing stops automatically. Simultaneously, the green light fades, a red light flashes on, and an alarm buzzer sounds.

Mounted on each air pressure gauge is a "lazy hand" which, if trouble occurs and testing comes to a halt, indicates the stage in which the pressure became excessive.

Doors at convenient locations were built into the wall separating the two areas and windows were provided at each test stand so that visual inspection of the compressor being tested at that desk is possible.

BEHIND A SOUND proof wall, on the other side of which are the control panels, compressors under test are mounted on the variable speed drives.

As tests are run at various speeds up to 4200 rpm, variable speed units with motors attached were installed for each cell to supply the power. The necessary spindle nose drives, fly wheels, and adaptors were designed and made by Kidde.

Each compressor is given an eight hour "Green Run In" or a performance test for specific periods at various speeds and pressures, ranging from 2000 to 3000 psi and from 1500 to 3750 rpm. During each stage of the run, a record is kept of operational performance after which the unit is dismantled and thoroughly inspected for wear or failure. If the compressor is found to be satisfactory, it is reassembled, and retested at the same pressures and speeds used in the "Green Run".

A functional test is then performed after the power drive unit is assembled to the compressor. This power unit depends on the customer's specifications and may be electric, a portable engine, mechanical drive, or a hydraulic motor for aircraft use.

The functional test consists of filling a given volume at the pressure required within specified time limits. These tests are made for both sea level and high altitude performances.

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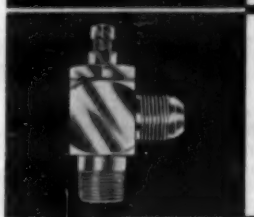
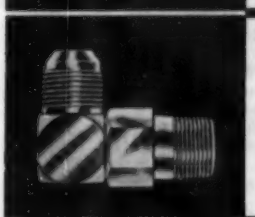


BALL CHECK VALVES
- Compact, bar stock body
- Tube or pipe outlets
- Fixed or adjustable spring loading



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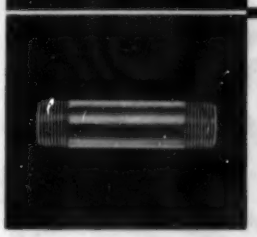

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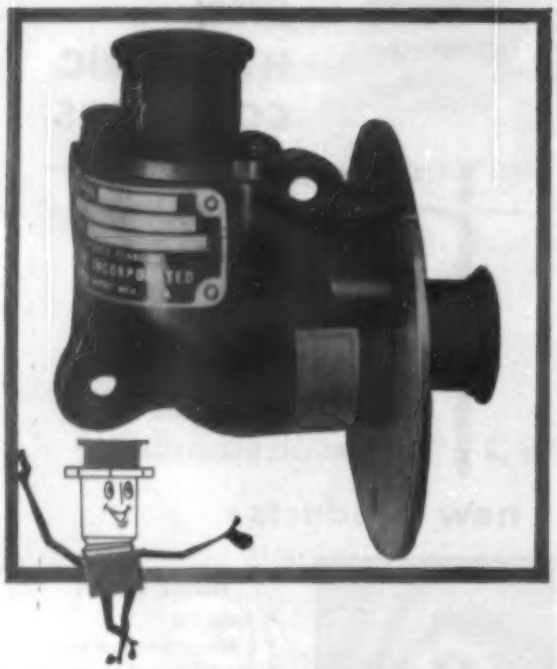


easily-applied CaPlugs keep Lear couplings dust-free ...protect threads

Furnished for use as an engine super charger blower shift control, this Lear model 197T Power Unit is provided with cost-saving protection during shipment and storage. Covering output couplings are tough, dependable Type EC CaPlugs. *Not only is thread damage avoided but dust and dirt are sealed out.*

In stressing other CaPlug advantages, Lear, Inc. states, "They are much easier to install and consequently effect a considerable saving in installation man-hours."

Made of flexible Polyethylene and impervious to all common chemical reagents, acids and solvents, multi-purpose CaPlugs will not chip, break or shred under most severe conditions. Furnished in 4 standardized designs, they are promptly available in a wide range of sizes to meet a wide range of requirements.

Write for catalog, price lists and free CaPlug assortment.

CaPlugs

DIVISION

PROTECTIVE CLOSURES CO., INC.

2201 ELMWOOD AVE. BUFFALO 23, N. Y.

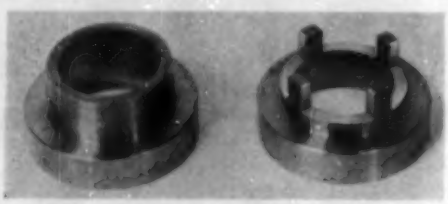
TAPERED CAPLUGS
For use as caps or plugs, inside or outside of threaded or plain fittings.
EC SERIES
Thread-protecting dust caps for electrical connectors. Fit over threaded or plain fittings.
CO SERIES
Threaded seal and shipping caps. Knurled for ease of application.
PO SERIES
Threaded Plugs for aircraft and hydraulic tube fittings. Seal beyond ordinary requirements.

Oil Powered Indexing

of gear broaching fixture

TO OBTAIN high production broaching of small automotive transmission parts, a hydraulically powered holding fixture was designed. The fixture is shown, in the photograph, mounted on the machine.

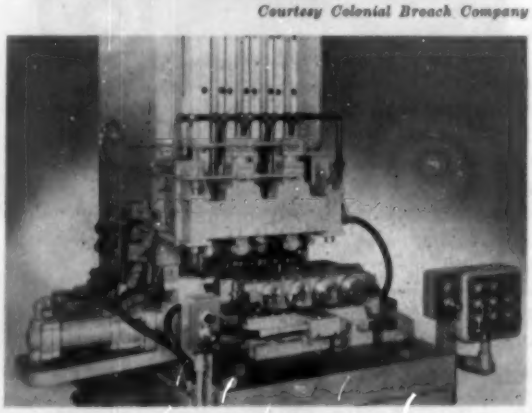
Four parts are broached at one time on the two-sided fixture, with one side being loaded and unloaded during the broaching operation on the opposite side. The fixture is indexed hydraulically 180 degrees; the two outside parts are unloaded; the two partially completed gear blanks are moved to the outside positions,



THE JOB: 280 of these transmission parts are broached each hour.

THE MACHINE: Indexing of the fixture is powered by the hydraulic cylinder on the left. Equalizing pads are attached to the rod end of the two clamp cylinders which are seen above the fixture.

Courtesy Colonial Broach Company



and then two blanks placed on the two center work holders.

During the broaching operation, the gear blanks are held in position by means of overhead hydraulic cylinders with equalizers,, one cylinder for each two stations. The unloading of the parts is facilitated by an automatic parts ejector which ejects the parts after each index. Distortion of the tangs is prevented during the broaching operation with back-up bars which are mounted vertically on the face of the part holding fixture.

The finished part has four tangs .340-.350 inch wide and .431 inch deep.

COOLING HYDRAULIC OIL

for world's largest stretch-wrap forming machine

...A ROSS EXCHANGER

Forming metal skins for aircraft, this giant Hufford Model 60 Stretch-Wrap Forming Machine (rated the world's largest) is capable of exerting a total pull of 703,720 lbs., at 2000 psi.

To maintain the total 115 gpm capacity of the machine's three constant delivery vane type pumps — *by providing safe, dependable cooling of the oil in the reservoir* — a Ross Type BCF Exchanger has been furnished. Capacity-robbing thinned cut oil, because of overheating, is effectively prevented. *Rated hydraulic power is thus insured!*

"We have been using Ross Exchangers for several years . . . they are compact, easy to install and perform satisfactorily . . . we have had full cooperation at all times during our business association," states Hufford Machine Works, Inc.

Widely preferred by numerous manufacturers of hydraulic machinery, Ross Type BCF Exchangers are pre-engineered, fully standardized and promptly available.

Why not learn more about these all-copper and copper alloy units that are unequalled in thermal efficiency and ruggedness? The facts are yours in Bulletin 1.1K5. Write.

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DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

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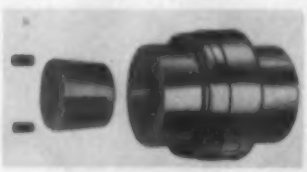
NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid power systems are described here . . . for more information fill in and mail the post card bound in this issue.

Continued from page 16

TYPE C COUPLINGS
. . . used with taper-lock bushings

Size: The three sizes of the type C coupling which are available for use with taper-lock bushings

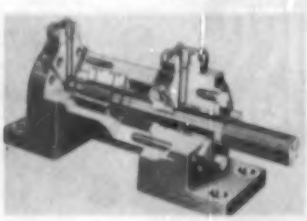


are: C-191 (Dodge Bushing No. 2012) for bores ½ to 2 in; C-226 and C-276 (Dodge Bushing No. 2517) for ½ to 2½ in bores.
Design: Permits easy fastening to shafting with the firmness of a shrunk-on fit, couplings adapted to taper-lock bushings permit distributors to carry a smaller number of coupling bodies taper-bored for taper-lock bushings.

Lovejoy Flexible Coupling Co.,
Chicago 44, Ill.
Circle 207 on Reader Service Card

HYDRAULIC CYLINDERS
. . . for 3000 psi

Designation: 3000 Series
Features: A wide range of standard mountings are available such



as foot, side lug, centerline, clevis, base, flange, rabbet and subplate. Adjustable stroke cylinders are also available with foot or centerline mountings. Features of the new cylinder line include heavy duty construction, spring loaded piston rod packings for positive sealing, and mounting design making them interchangeable for reuse of equipment. End covers are solid steel, machined for perfect alignment of piston and rod. Cylinders are available with male or female, single or double end piston rods, with or without cushion and with many combinations of the mountings listed. The following optional rods are available. Chrome plated, hardened, or hardened and chrome plated.

Hydraulic Power Division
The Hydraulic Press Mfg. Co.,
Mount Gilead, Ohio
Circle 208 on Reader Service Card

SURFACE ROUGHNESS
. . . measured accurately

Designation: Surfindicator.

Design: Designed to measure the roughness of any surface. It provides a non-destructive test. The surface roughness range measured extends from 1 to 1000 microinches average deviation from the mean surface. A variable cut-off switch permits the separation of waviness and roughness characteristics of surfaces by filtering out wave lengths exceeding .003, .010 or .030 in.
Operation: When the diamond tip stylus moves across the peaks and valleys of the surface to be measured, the microscopic mechanical motion is transformed by a movable plate vacuum tube transducer into electrical signals.

Brush Electronics Company,
Cleveland 14, Ohio
Circle 209 on Reader Service Card

SELF CONTAINED POWER UNITS
. . . for hydraulic equipment

Design: Finger tip adjustment of line pressure is possible on the power units and all piping and

fittings are of high pressure steel and welded in the joints with flange connections to valves and pump to facilitate quick removal for repair. Each unit has magnetic starter, push-button control and each is factory wired. The motor and pump are direct connected and flange-mounted insuring accurate alignment.
Capacities: The oil hydraulic power units are available in a range of capacities from 7 to 54 gpm oil consumption or delivery of pressures of 200 to 1000 psi.
Construction: Rapid operation of equipment is facilitated by the 2 in. pipe delivery and return. The unit is complete with reservoir, accumulator, baffled type oil cleaner, automatic water cool-

ing, all electrical switching gear with overload protections and 2 in. high pressure shut-off valve.
Feature: The pumps are completely unloaded when the pressure setting is reached and do not pump against a pressure head or relief valve.

Harvill Manufacturing Company, Corona, Cal.
Circle 210 on Reader Service Card

VACUUM GAGE . . . indicates clogged filters

Designation: IMS Pump Saver
Design: This gage is installed in the intake lines of injection ma-

chines and indicates when the filters or intake screens are becoming clogged with lint and dirt. A safe operating range, a questionable operating range and a danger zone are clearly indicated on the dial so that the injection molder can anticipate the need for cleaning the filters before damage occurs.
Construction: The gages are installed by drilling and tapping the intake line between the tank and the pump of any injection machine. The gage faces are plainly marked both in words and colors so that the molder can determine the safe operating zone of the particular machine.

The Injection Molders Supply Company, Cleveland, Ohio
Circle 211 on Reader Service Card

HEAVY-DUTY LIMIT SWITCH . . . provides fast "break"

Designation: Loxswitch Series L100
Design: Moving contact bars can be removed from the front

Keeps Oils Clean

EVEN WHEN SYSTEMS AREN'T DRAINED FOR A YEAR!

GENERAL AF-500 *Industrial* FILTERS

Keeping hydraulic and lubricating oils free from impurities can be a costly process — one demanding the frequent draining and refilling of entire oil systems. But with the GENERAL AF-500's positive absorption . . . moisture, dirt, rust, tars and lint are *safely trapped* in the finest wool felt, assuring trouble-free, uninterrupted operation of oil systems for as long as a year! Machine parts are protected from abrasive wear and maintenance costs are reduced on both new and old equipment.

No other Filter like it!

TWO-FOLD ELEMENT
The AF-500 actually works two ways — its ALL-WOOL felt element traps *moisture* and dirt particles as fine as *5 microns.*

CLEAN, SAFE LIQUIDS
Clean, completely dependable oils, paints, lacquers and other industrial liquids are assured at 15-20 gpm, depending on viscosity.

LONGER MACHINE LIFE
Both on new and old equipment, GENERALS protect vital machine parts from abrasive wear, greatly prolonging service life.

SIMPLE DISASSEMBLY
Cleanable wool felt cartridge can be quickly removed and washed in any suitable solvent without disturbing inlet or outlet lines. Merely unscrew center bolt, lift off cover and two washers, and remove felt cartridge intact.

WRITE us — without obligation — about your industrial filtering problems.

GENERAL FILTERS, INC.
43800 GRAND RIVER AVENUE • NOVI, MICHIGAN
CANADIAN GENERAL FILTERS, LTD., 2679 DANFORTH AVENUE
TORONTO 13, ONTARIO

Continued

of the switch in less than 5 seconds. Being of solid silver they can be reversed and reinserted for double life. All stationary contacts can be changed in 30 seconds by removal of two screws from the back of the switch.

Construction: Solid silver contact bars, weighing only 1/10 oz. are the only "floating" components. They are carried in a balanced rotor and are locked in each closed position under 10 oz. spring pressure. Operating pressure has been reduced, being only 45 in oz., without return spring and only 185 in oz. with return spring and full overtravel. Without use of overtravel, the switch has passed 25,000,000 actuations.

Features: A single-pole double-throw double-break switch which because of its unique trigger-type mechanism provides unusually fast and accurate "break". Repetitive accuracy is within .03 degrees.

R. B. Denison Mfg. Co., Cleveland 3, Ohio

Circle 212 on Reader Service Card

BOOST PUMPS

High Pressures

Low Prices

Measures 8¼" wide x 9⅝" deep.

Boost 100 PSI. air pressure to 10,000 PSI. fluid pressure for $173.25 (FOB Gardena, Calif.). Eight standard models for output fluid pressures of 1,000 to 30,000 PSI. Special models for lower or higher pressures.

Applicable wherever low volume output at high pressures is the requirement. For oil or water service. Complete power packages also available. Send for bulletins.

Assembly No.	Ratio	Maximum Fluid Pressure	Prices, F.O.B. Gardena, Calif.
216-C- 10	10:1	1,000 PSI.	$230.00
216-C- 20	20:1	2,000 PSI.	210.00
216-C- 35	35:1	3,500 PSI.	173.25
216-C- 60	60:1	6,000 PSI.	173.25
216-C-100	100:1	10,000 PSI.	173.25
216-C-150	150:1	15,000 PSI.	196.50
216-C-200	200:1	20,000 PSI.	225.00
216-C-300	300:1	30,000 PSI.	289.50

SPRAGUE

Engineering and Sales Corp.

1144 West 135th Street, Gardena, California

UNLOADING VALVE
. . . for pressures to 3000 psi

Size: ⅜ and ¾ in npt

Features: The valves are easily

adjustable and maintain desired pressure settings without readjustments. Large internal passages assure maximum flow with minimum pressure loss. No external drain lines are required. Available in two pressure ranges, 500 to 1500 psi and from 1500 to 3000 psi.

Waterman Engineering Company, Evanston, Illinois

Circle 213 on Reader Service Card

HIGH PRESSURE CYLINDERS
. . . 5 to 50 tons capacity

Design: High pressure double acting hydraulic cylinders from 5 to 50 tons are streamlined in appearance. The rear housing is suitable for trunnion mounting and is suited for installation in

machinery or plant where only slight movement of the ram is necessary when in operation. The maximum working pressure is 5000 psi and ⅜ in bsp, tapped holes are provided in the caps at either end for connection purposes.

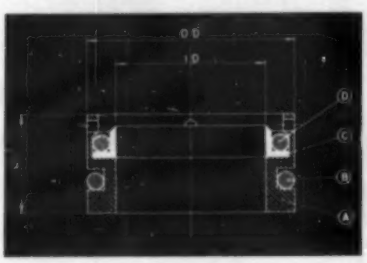
Construction: The cylinders are manufactured from smooth bore solid drawn hydraulic tubing and the rams of high quality steel of adequate strength and proportion. Twin "V" packings and "O" type seals are used to ensure maximum efficiency and freedom from leaks.

Specifications: The standard specification provides for a maximum stroke of 12 in. in each size of ram but this can be reduced to meet customer's requirements.

Messrs. Chamberlain Industries Limited of Staffa Works Leyton, England
Circle 214 on Reader Service Card

LOW FRICTION PACKING . . . is one piece cartridge

Construction: When Teflon is used it needs to be forced into sealing contact with the moving element as it does not itself assume or maintain that contact. Experience with the common



"O" ring has confirmed its usefulness as static seal and its weakness as a moving seal, particularly under higher pressures. The low friction qualities of the Teflon in comparison with the live-action qualities of the "O" ring make a seal which seems to have the desired capabilities. In order to avoid obsoleting present valve parts, this seal is incorporated into a cartridge comparable in size with former packings. This cartridge must be sealed to the stuffing box and so the static sealing qualities of the "O" ring are here used again.

Features: The one piece cart-

ALL COMERS!

HERE'S THE CHAMP

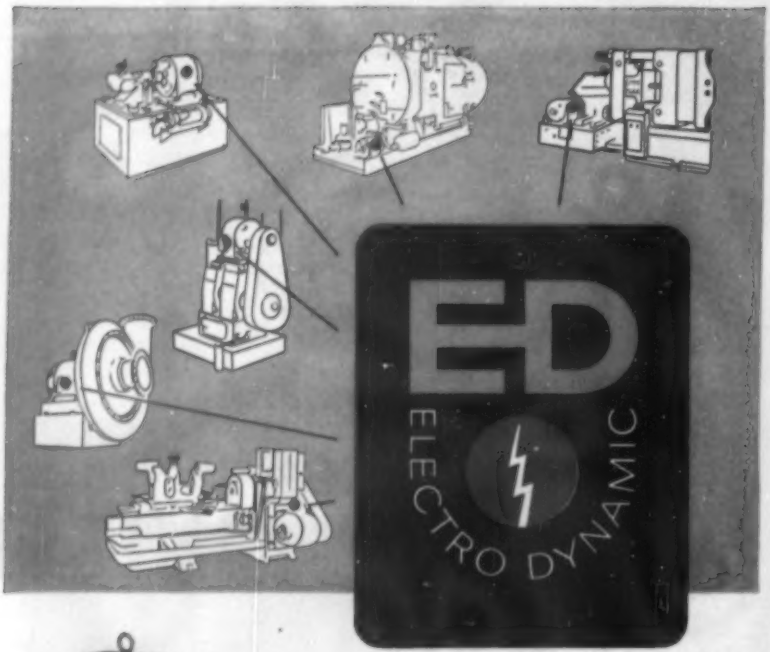
. . . YOU SUPPLY THE CHALLENGER

The difficult fluid, gas, or air transmission problem in your plant — We'll send you a Snap-Tite Hi-Flow quick connect disconnect coupling — double or single shut-off or straight-thru — any size 1/8" to 3" — Test it! In your Plant, under actual working conditions — You be the judge — If it doesn't do a better job than the coupling you're now using — Or solve your problem — Ship it back collect! Fair enough? — Write today on your letterhead, briefly outlining your problem — We'll ship immediately.

Snap-tite INC.

201 S. Cherryton, Union City, Penna.

Circle 114 on Reader Service Card



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Conclusive evidence of the *extra dependability* of Electro Dynamic motors is now revealed in the new candid report **"MOTOR SHOWDOWN"**. The revealing proof is found in *comparative tests** conducted in accordance with A.I.E.E. standards. Don't miss your copy! Send the coupon below *today*.

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1 to 250 hp. AC and DC. Standard or special purpose. N.E.M.A. standards.

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170 Avenue A, Bayonne, New Jersey

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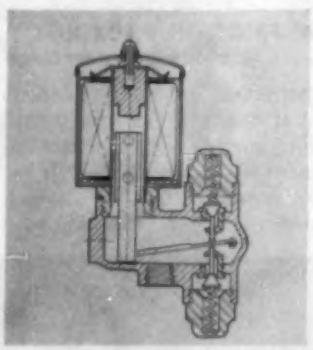
COMPANY_____
ADDRESS_____
_____

ridge is possible because the Teflon could be distorted enough without damage to snap into place and the flexibility of the "O" ring permitted it also to be snapped into place. Once assembled, it is practically impossible to remove them from the cartridge without destroying them.

Emmett Machine & Mfg. Inc., Akron 14, Ohio
Circle 215 on Reader Service Card

3-WAY SOLENOID VALVES . . . for high temperature

Size: Pipe size 1 in; port orifices (5 in number) ⅛ to ⅜ in
Construction: The solenoid valves are constructed with either steel or stainless steel bodies. Both types have stainless steel trim throughout and are designed to handle a wide variety of gases and liquids usually corrosive to bronze, brass



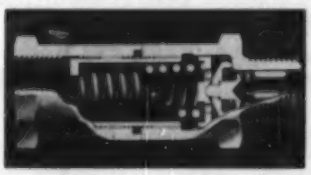
and cast iron. When equipped with high temperature coils, these valves will also handle gases to 450 F. Valves are available with water tight and explosion-proof solenoid enclosures. Valves are packless having no sliding glands or stuffing boxes.

Application: Frequently employed for pilot control of diaphragms and for applying and exhausting pressure from single or double acting cylinders. They are used for direct control in chemical processing applications to divert and select flow from one or two pipe lines, and find applications in refinery type service.

Automatic Switch Company, Orange, New Jersey
Circle 216 on Reader Service Card

RELIEF VALVE
. . . has stabilized action

Designation: 5100 Series
Sizes: ¼, ½, ⅜, ¾, and 1 in
Design: Design and in-line construction provides flow characteristics without the complication of pilot operation. Performance curve shows a slight but regular increase in pressure drop



with increasing flow rate, which serves to stabilize the action. "O" ring seal is used and a spring centering device which allows only axial force to be transmitted to the poppet.
Construction: Lightweight made possible by the in-line design. Adjustment of cracking pressure within ± 15 percent of nominal can be made by using a standard Allen wrench to rotate the threaded spring retainer. Interchangeable replacement springs can be used to provide a wider range of adjustment. Available either in steel or brass for pressures from 50 psi to 1000 psi.

James-Pond-Clark
Pasadena 8, Cal.

Circle 217 on Reader Service Card

ELECTRIC MOTORS
. . . meet new NEMA Standards

Designation: L. A. Line
Design: Bearing construction, an important factor has been im-

proved over previous designs. Bearings are lubricated at the factory with ample grease supply to give years of service in normal usage without maintenance or attention. Bearing grease seals have been designed for greater effectiveness to prevent grease from leaking along the motor shaft.
Construction: Conformance to smaller external dimensions has been accomplished by using larger lamination diameters and longer stacking with shorter coil ends. The line has virtually the same amount of active material for each hp and speed as older, bulkier units. It delivers, therefore, the same performance as previous units with comparable starting and breakdown torque. Efficiency power factor, temperature rise and service factors.
Features: More efficient and effective ventilation, obtained through utilization of aerodynamic principles. A new type

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GOSHEN O-RINGS
is yours FREE!

See our catalog in Sweet's Product Design File.

Write today for your free copy of this brand new booklet packed with information on sizes, groove dimensions, and compounds. It's designed to be helpful to users of O-ring seals for most every type of application.

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1534 S. Tenth St., Goshen, Indiana

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Company .....
Street .....
City ..... State .....

Goshen Rubber Co. INC Goshen, Indiana

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★ DETACHABLE HOSE FITTINGS
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STRATOFLEX Hose Fittings and Hose Assemblies are designed to give dependable service and maximum performance. Cost-minded operators in the industry recommend STRATOFLEX! Whatever your requirements in flexible hose assemblies and detachable reusable hose fittings — or elbow hose fittings — specify STRATOFLEX!
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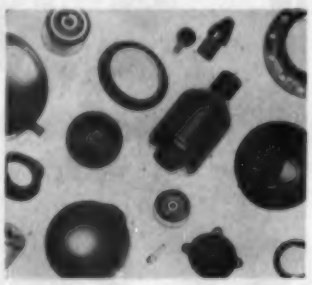
STRATOFLEX OF CANADA, Inc., TORONTO 18, ONTARIO

coduit box arrangement is designed for ease of electrical connection and to provide positive lead identification.

Louis Allis Co.,
Milwaukee 7, Wis.
Circle 218 on Reader Service Card

MOLDED RUBBER PARTS
. . . for individual requirements

Applications: Custom molded silicone rubber parts for automotive, aircraft, electrical, equipment and other industries.
Service: Parts with excellent service under adverse operating conditions are being produced to commercial and government specifications by transfer, injection and compression molding. Its complete service includes compound formulation, complete mold-making facilities and



full acceptance of responsibility from blueprint to the finished part. Rubber-to-metal bonds are made to tolerances as close as 5 microfinish.

Stillman Rubber Co.,
Culver City, Cal.
Circle 219 on Reader Service Card

HYDRAULIC FLUID BOOST PUMP
. . . for aircraft

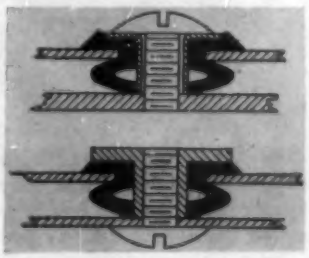
Designation: AA 15500 Series
Design: A 3000 psi fluid motor is combined with the two stage booster pump. Fluid is bled off the main hydraulic system to power the motor which turns the pump. Gravity feeds reservoir oil into the first stage of the boost unit, a centrifugal pump. The centrifugal section then passes the oil to the vane pump section which generates hydraulic system supply pressures up to 100 psi.
Specifications: The oil booster pump can generate hydraulic power varying between 5 gpm at a differential pressure of 100 psi and 35 gpm at a differential pressure of 18 psi.
Applications: Used where hydraulic reservoirs are located an

extended distance from the system hydraulic pumps or where altitude problems exist. It provides reservoir oil under pressure to overcome line losses and assures that an adequate supply of oil is available at the main system pump(s) for most efficient operation. It is not necessary to pressurize a reservoir when the booster pump is used.

Vickers, Inc.,
Detroit 32, Mich.
Circle 220 on Reader Service Card

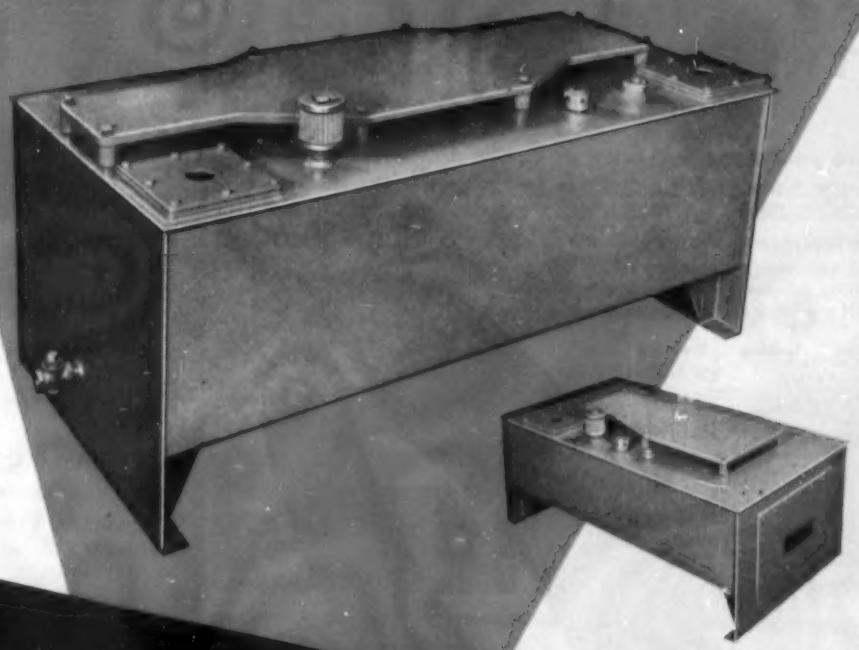
ISOLATION OF NOISE
. . . with T-nut isolator

Design: The T-nuts will fit through plates up to 3/16 in thick, in four available core lengths. Only 1/16 in to ⅛ in



clearance is needed between the isolated assembly or unit and the mounting panel. The core is

Announcing A New Service For Equipment Manufacturers



Ready-Made Hydraulic Tanks (J.I.C. Standards) For Power Units...

A complete line of Cardwell Hydraulic Reservoirs fully equipped with Reservoir Components are now available to the Hydraulic Industry. Cardwell tanks (J.I.C. Standards) have established an enviable record in the Industry and you will find these units ideal for your Hydraulic Assemblies. Write for catalog or price quotations for standard or special sizes.

The CARDWELL MACHINE COMPANY

Quality A CARDWELL TRADITION SINCE 1919

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Custom Engineered * *to Your Specifications!*

MARSH IMPREGNATED THERMO LEATHER PACKINGS

Where your need is quality controlled leather packing

• to serve a specific static or running application • to fit a special temperature range • to meet specific pressure requirements

Marsh Impregnated Thermo Leather Packings are Custom Engineered!

Where you specify leather packing for operating pressures, for pressure mediums, MARSH provides superior custom packing!

* Forming Cutting Treating

- **Low coefficient of friction** both static and running
- **Greater wear resistance** combines toughness with strength
- **Tighter sealing** proper impregnation for varied pressures
- **Temperature stability** through a wide range of temperatures

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If you seal oil, water, air, vacuum, gas, gasoline, naphtha, alcohol or other fluids, ask MARSH for field engineering service, immediately available to you for the job you are designing, tooling, manufacturing.

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New Products

Continued

either clearance-drilled or tapped for any of several common machine screw threads. The resilient material is either rubber, GRS, or neoprene.

Features: Low cost, ease of installation and effective isolation of noise and high-frequency vibration.

Application: Used to quiet small motors, to isolate sensitive assemblies in aircraft and guided missiles, to protect panel mounted instruments and to reduce transformer hum. With a natural frequency of 35 to 40 cps, they provide isolation of disturbing vibrations at 100 cps and above.

The Barry Corporation
Watertown 72, Mass.

Circle 221 on Reader Service Card

DETACHABLE COUPLER . . . is automatic

Designation: Foster-matic
Features: Cannot be hammered

to pieces by reciprocating air tools. It will not fall apart or blow apart, holds tight yet swivels freely. The half moon "dogs" on the coupler offer long bands of gripping contact. "Dogs" lock at 45 degrees and are positioned by a floating steel carrier.

Application: Recommended for air reciprocating tools.

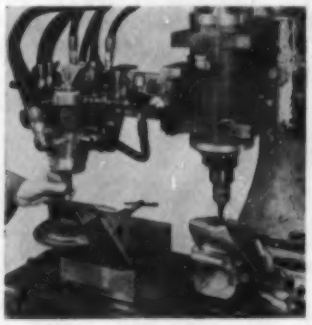
Foster Manufacturing Company.
St. Louis 18, Mo.

Circle 222 on Reader Service Card

HYDRAULIC TRACER . . . is 3 dimensional duplicator

Designation: Model A-3D
Features: Up to this time, vertical and horizontal mills, planers, spar mills, boring mills, lathes and hand duplicators have been able to obtain precision duplication of any configuration within 180 and 360 degrees. This model traces 360 degrees in all

directions. The tracer converts a miller or other accurate metal cutting machine tool into a high precision, high production, 3 dimensional duplicator. The tracer



can be made to follow a low-cost, one-to-one ratio 3 dimensional wood, plaster or metal template with the same ease as would be required to trace the template with a pencil.

Application: The airplane requires many irregularly contoured parts. The tracer enables the airframe manufacturer to make a small number of each contoured part at from twice the speed to as low as 16 percent of former metal cutting costs.

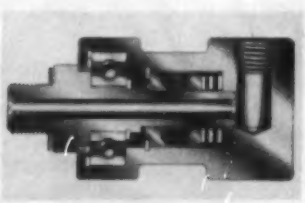
True-Trace Sales Corp., El Monte, Cal.

Circle 223 on Reader Service Card

REVOLVING JOINT . . . for air and hydraulic use

Designation: Type NV

Construction: Connection to rotating machine or part is made



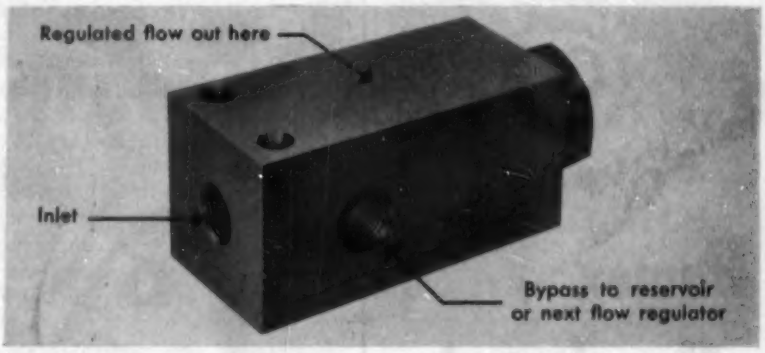
by screwing the male threaded steel shaft of the joint into the hub of the chuck or clutch. The shaft is drawn up tight so that seal is made by the washer.

Features: An improved light running revolving joint for making air or hydraulic piping connections to clutches, power transmission drive units, chucks, spindles, grinding wheels and other rotating machine parts.

Circle 43 on Reader Service Card

NEW! FLOW REGULATOR

Combination Bypass and Restrictive Type



- **Constant Regulated Flow**
- **Can be used in series to control two or more flows**
- **Pressure compensated, not affected by pressure or temperature**

- For oil 100 to 3000 P. S. I.
- Regulated flow ½ to 7½ G. P. M. non-adjustable; specify flow desired
- ¼" and ⅜" pipe sizes

Write for detailed engineering data and prices.

Manufacturers of Hydraulic Valves and Devices

Fluid Controls, inc.

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Clamping Valves
Small Spring Loaded Accumulators • Special Valves

1284 N. CENTER STREET • MENTOR, OHIO

WHAT *features* DO YOU WANT *in a* Universal Joint?

- Maximum strength and bearing surface
- Quick-acting, dependable response
- Long service-life
- Optimum operating angle
- Close quarter operation
- Accurate surface grinding
- High concentricity
- Minimum weight

LOVEJOY HAS THEM ALL!

Available in 13 standard sizes—diameters ½" to 4"—bores ¼" to 2"—lengths 2" to 10⅝"

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LOVEJOY FLEXIBLE COUPLING CO.

4837 W. LAKE ST. CHICAGO 44, ILL.

Also manufacturers of flexible couplings, variable speed pulleys and transmissions.

Pantex Manufacturing Corporation

. . . established in 1927 and one of the largest manufacturers of hydraulic valves for aircraft manufacturers, has available an unusually effective and adaptable line of hydraulic controls for industrial applications.

Designed, engineered and manufactured to highest performance standards, each Pantex unit is analyzed, tested, and inspected in one of the most modern hydraulic laboratories.

Literature available.

Pantex
MANUFACTURING CORPORATION
PAWTUCKET, RHODE ISLAND

563

. . . specialists in hydraulic controls

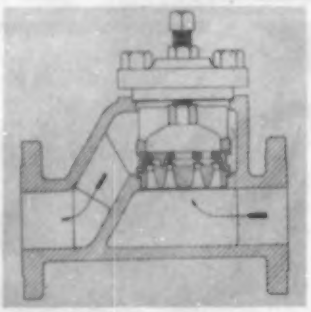
They have a compact new one piece bronze casing, special spring loaded V-ring seals, hardened and ground steel shaft and permanently lubricated, sealed ball bearing.

Specifications: The shaft is made with a right hand 5/8-18 NF3 straight machine thread end and the inlet in the casing is tapped with a standard ¼ in. pipe thread. The joint is suitable for use at temperatures up to 180 F and pressures to 300 psi (air) or 1500 psi (hydraulic). Maximum speed recommended is 2500 rpm.

Barco Manufacturing Co., Barrington, Illinois
Circle 224 on Reader Service Card

AIR CHECK VALVES
. . . for high pressure

Feature: Installed in the discharge line of air and gas compressors this valve checks down-



time, noise, vibration and tank ring also it replaces stop and safety valves. The valves are automatic.

Application: For higher than usual pressures to suit conditions of service as high as 500 psig.

Pennsylvania Pump & Compressor Co., Easton, Pa.
Circle 225 on Reader Service Card

SNAP-ACTING SWITCH
. . . has direct acting actuator

Designation: Type MXT-1
Design: Accurate repetition of operate point, in a snap-action switch for use where low operating force is desirable. This design utilizes a rigid lever arm, pivoted on a bearing pin, set in supports integral with the molded cover of the switch. The actuating arm can be furnished in

any desired length and with special bends. The actuator can be modified by eliminating the coil spring, to permit operation at forces down to 15 grams.

Applications: Suitable for use in cam, or slide-operated controls. It carries a current rating of 15 amperes at 125 volts ac.

Unimax Switch Division of The W. L. Maxson Corp., New York 1, New York
Circle 226 on Reader Service Card

DIAPHRAGM TYPE COMPRESSOR
. . . for low pressure air

Designation: DP4
Construction: A three ply diaphragm takes the place of the usual cylinder and piston, avoiding the necessity for the presence of oil in the compression chamber. The connecting rod is an aluminum alloy casting shaped into a circular disc at the

upper end upon which the diaphragm is seated. At the top of the compression stroke the disc conforms to the contour of the diaphragm which has its outer extremities nipped between the main casting and the compressor

Circle 96 on Reader Service Card →

Now . . .

greater performance

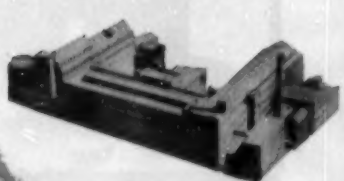
from Hydraulics!

Pantex

1/4" Directly Operated 4-Way Valve
Solenoid Controlled
100-5,000 p. s. i.

This Pantex 4-Way Valve, operating at pressures up to 5,000 p.s.i., can be easily mounted on *existing* lower pressure installations where a higher pressure is desired.

Most Compact,
sub-plate mounted.
Detachable Coils,
quickly, inexpensively replaced.
Low Inrush Ampere Factor,
much less than others.



Also available —

Relief Valves
350 — 5,000 p.s.i.

¾" Pilot Operated 4-Way Valves
Remotely Controlled
100 — 5,000 p.s.i.

¾" Pilot Operated 4-Way Valves
Solenoid Controlled
100 — 5,000 p.s.i.

. . . hydraulic control specialists . . .

Pantex

since 1927

MANUFACTURING CORPORATION
PAWTUCKET, RHODE ISLAND

Continued

head. The plate holding the diaphragm in position on the disc also houses the ring type inlet valve, the ports being carried through the diaphragm and the connecting rod head. The connecting rod is split at the bottom to accommodate the sealed grease-packed ball race constituting the big end bearing. Equipped with a carbon air intake filter.

Feature: It is silent in operation. There is no perceptible vibration, as both crankshaft and connecting rod are balanced. No lubrication is required.

Specification: The maximum working pressure is 30 psi at 1450 rpm. Delivery is 2 cfm of free air at 10 psi.

Application: Provides small quantities of low pressure air free from oil and other impurities. It is intended for use in food processing, raising consumable liquids, pressurizing instruments.

The Hymatic Engineering Company Ltd., Redditch, Worcs. England.

Circle 227 on Reader Service Card

"FULFLO" VALVES

By-pass, oil-relief piston type hydraulic

NO TRICK AT ALL . . .

Standard and Flange models

Just select from 5 springs, install and your FULFLO VALVE is ready to go to work . . . TO MAINTAIN CONSTANT, UNIFORM PRESSURE . . . from 0 to 500 psi.

NON-CHATTERING, TOO . . . because the cylindrical piston closes off the port in a shearing manner.

FOR . . . machine tool hydraulic mechanism, oil-burning equipment, rams, presses and Diesel engines.

Pipe sizes: ¼" to 2"

WRITE—on your letterhead, please, for personal copy of FULFLO MECHANICAL DATA BOOK

Specify if for Valves, for Pumps or for both.

FULFLO

THE FULFLO SPECIALTIES CO. Inc.

PUMP AND VALVE MANUFACTURERS

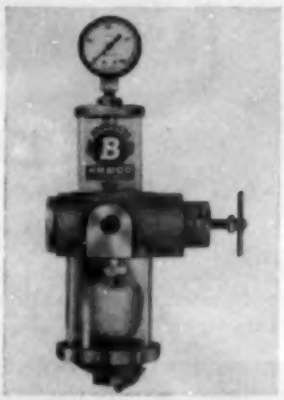
BLANCHESTER, OHIO

FILTER-LUBE-REGULATOR . . . for compressed air lines

Designation: Type RFL

Size: ¼ to ¾ in.

Design: A new combination filter, regulator and lubricator for compressed air lines is designed to eliminate the complicated piping and fittings required for the installation of individual filters, lubricators and regulators. Piping is simplified, only two connections are required for connection in any air line.



Features: The filter provides maximum filtering area. Transparent bowl shows when the filter is dirty. The filter element can be quickly changed. The unit is a lubricator. The oil reservoir can be filled without shutting down the air line. It also regulates pressure. Non-diaphragm design provides close control for air operated equipment requiring 0 to 100 psi in 2 psi increments and 0 to 200 psi in 5 psi increments. The unit will bleed down stream lines to any required pressure between line pressure and atmosphere. It also acts as a shut-off valve. At shut-off it automatically bleeds downstream line to atmosphere.

The CCA Products Division, Breco Manufacturing Company Baltimore 2, Maryland

Circle 228 on Reader Service Card

THREADS RESTORED . . . without decreasing size

Designation: Nu-Trix

Sizes: It is available for either national coarse or national fine threads. There are eight thread sizes on each tool. No. 1 (NC) is for 11,12,13,14,16,18, 20 and

24 threads per inch. No. 2 (SAE) is for 9,10,15,16,20,26, 28 and 32 threads per in.

Application: External threads, which have been damaged or deformed, can be quickly returned to original condition without reducing the root and outside diameters. The tool eliminates shaping with a three-cornered file or the use of a die, which removes metal from the thread diameters. Both methods result in loose fits. Used like a file a few quick passes across the damaged threads will remove burrs and deformed metal and reshape threads to original condition.

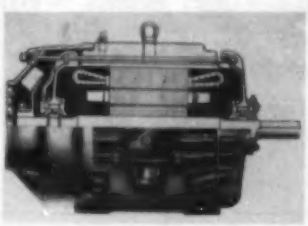
Reiff & Nestor Company, Lykens, Pa.

Circle 229 on Reader Service Card

INDUCTION MOTOR . . . for out-door applications

Designation: Type AK

Design: For out-door applications and suited to installations inside plants where moist, dirty or corrosive atmospheres exist. Due to its single cast iron frame construction, the motor provides



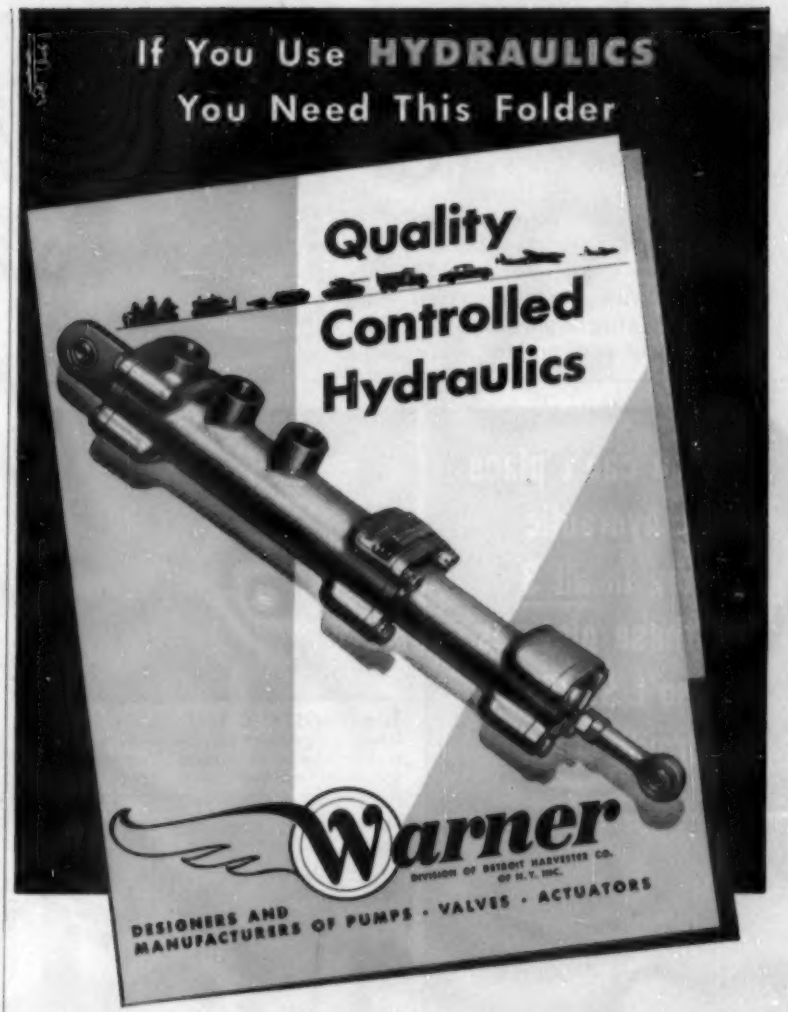
good heat dispersal by means of its cooling fins and avoids obstructions caused by excess dust particles which tend to collect inside double frame motors.

Features: Totally enclosed and fan-cooled, the motor is built to provide full protection to all parts against harmful surrounding atmospheres. This squirrel-cage induction motor also features low starting current.

Specifications: The rotors are electronically tested and dynamically balanced in the plant to close tolerances. Equipped with dust tight bearings, cast iron cooling fins and one piece aluminum fan.

The Belgian Electric Sales Corp., New York, New York

Circle 230 on Reader Service Card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You Need This Folder
Quality Controlled Hydraulics
Warner
DIVISION OF DETROIT HARVESTER CO. OF N.Y. INC.
DESIGNERS AND MANUFACTURERS OF PUMPS • VALVES • ACTUATORS

Warner's Extension Power Brake Valve, shown above, has an exclusive hydraulic feed-back feature to give the pilot immediate warning in event of hydraulic system failure. This compact, lightweight, space-saving valve is adaptable to a wide range of system and brake pressures.

Warner is qualified by experience and facilities for the design and production of critical hydraulic equipment for a wide range of uses. Warner engineers will welcome an opportunity to assist you in the development of special hydraulic equipment to meet your particular requirements.

Write for your copy of the illustrated folder shown above describing typical examples of Warner precision hydraulic equipment.

Warner DIVISION OF DETROIT HARVESTER CO. OF N.Y. INC.
21537 GROESBECK HIGHWAY • P.O. BOX 3886 • DETROIT 5, MICHIGAN
DESIGNERS AND MANUFACTURERS OF PUMPS • VALVES • ACTUATORS

Circle 131 on Reader Service Card

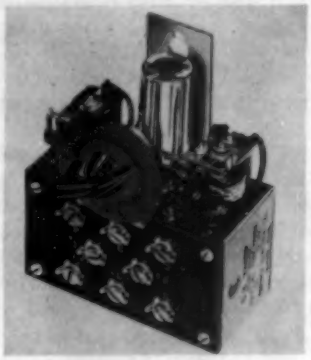
Continued

ELECTRONIC TIMER
. . . has non-repeat feature

Designation: Models CS4 and DS4 of the Type CK timer.

Design: Operates directly from 105-125 volts, 60 cycles. Its relay handles 8 amperes at 125 volts AC with a non-inductive load, in a single-pole double throw circuit with no intermediate OFF. A set of single-pole normally open contacts, also rated at 8 amperes, closes at the start and opens when the timer is re-cycled.

Feature: The non-repeat feature increases the usefulness of the timer in many short interval timing operations such as feeding work into machines, energizing solenoids and spot welding. The timer will operate without danger of repeating either when started by a momentary contact or by a contact that exceeds the



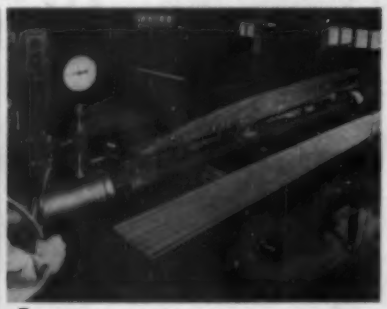
duration of the timed cycle. It does not reset automatically until after the start switch is released.

Construction: No filament current is required, there is no wear on the tube during stand-by periods, timing is instant without warm-up and the timer can be re-cycled immediately with no delay for recharging a timing capacitor. Ranges available are 1, 5, 3, 6 or 12 seconds. A dial with 100 graduations allows the timer to be set for any desired percentage of the total range.

Farmer Electric Company
Waban 68, Mass.

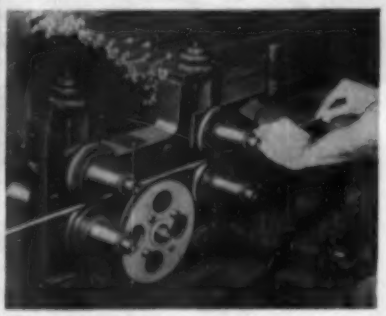
Circle 231 on Reader Service Card

If you can't place your hydraulic tubing in all 3 of these pictures it isn't SUPERIOR hydraulic tubing



1. HYDROSTATIC TEST—Every single length of Superior hydraulic quality tubing is 100% hydrostatic-tested. This is only possible, economically, because of Superior's invention of a super-speed clamp.

2. FLAREABILITY TEST—Each order of Superior hydraulic tubing is sampled for flareability. Superior's low-carbon Hydraulic Tubing (0.12% maximum) greatly increases ease of flaring and bending.



3. MARKING—Every length of Superior hydraulic tubing is marked with indelible ink so that you cannot mistake that it is hydraulic quality and its source is Superior.

Superior low-carbon Hydraulic tubing is specially made to attain a non-aging tubing with low ultimate tensile strength and high elongation for good ductility.

Sizes available from all Superior distributors—.125" to 1.125" O.D. Temper #1, dead-soft annealed, Bulletin 38 will bring you complete information on analyses, sizes, lengths, properties, and recommended working pressures. Use the coupon.

Superior
THE BIG NAME IN SMALL TUBING

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"STOCK" CYLINDERS
. . . in popular sizes

Sizes: Non-cushioned: 2, 2½, 4 and 6 in. bore air cylinders and 1¼, 2½ and 4 in. bore hydraulic cylinders, each of which are available in 2, 4, 6, 8, and 11 in. strokes. Cushioned both ends: 2 and 3¼ in. bore hydraulic cylinders and 2, 3¼, 5, and 8 in. bore air cylinders, each of which are available in 3, 5, 7, 9, and 13 in. strokes,

Design: The air cylinders are rated for 200 psi operation and

DIRECT HYDRAULICS IN HEAVY INDUSTRY

HYDRAULIC POWER AT THE FINGER TIP

Direct hydraulic power systems, powered by Electraulic High Speed Pumps, save money in the Shipyard — immune to frost — independent units not affected by demand of adjoining machines—any desired pressure immediately available—great economy of power and maintenance. The Electraulic All-Hydraulic Control System gives hydraulic pressure by finger-tip control, without solenoids.

The Plate Edge Planing Machine is illustrated by courtesy of Hugh Smith (Possil) Ltd.

ELECTRAULIC
REGD. TRADE MARK

HIGH SPEED PUMPS

DIRECT HYDRAULIC SYSTEM

TOWLER BROTHERS (PATENTS) LTD., RODLEY, Nr. LEEDS, ENGLAND

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It also happens in Hydraulic Systems

Unretouched Photomicrograph (100 x) shows steel particles which passed through an edge-type strainer with .003 in. spacing. The particles were extracted by a Frantz FERROFILTER installed in the headstock lubricating oil line of a W & S No. 5 turret lathe.

FERROFILTER

Magnetic Separators

are used also to protect hydraulic cylinders, pistons, valves, pumps and other components against damage from abrasive ferrous particles worn off moving parts. Install Frantz FERROFILTERS on your fluid power lines to reduce maintenance and parts replacement.

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S. G. FRANTZ CO., Inc.

P. O. Box 1138 Trenton 8, N. J.

the hydraulic cylinders for 2000 psi. The base model of the stock cylinders is Model 53. Mounting attachments are available for conversion to flange, foot or pivot mounting.

Construction: The "stock" cylinders have solid steel, heads, caps and mountings, hard chrome plated piston rods, dirt wiper seals, leakproof piston and rod seals that never require adjustment.

Miller Fluid Power Company, Melrose Park, Illinois
Circle 232 on Reader Service Card

HYDRAULIC BENDERS . . . for steel tubing

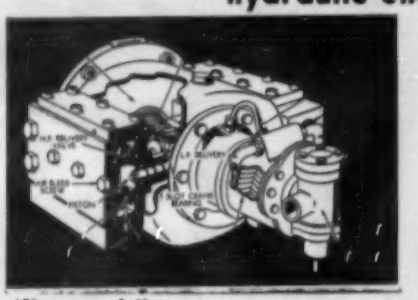
Feature: The hand operated version utilizes a two-stage hydraulic pump, having a bucket type low pressure piston, in order to bring the ram to its work quickly, and then by means of a quick action dog, bringing into operation a smaller diameter high pressure piston, to carry out the actual bending operation. One of the most unique features of these machines is the method of

automatically ejecting the tube from the center forming die after forming the bend. Usually the tube is gripped very tightly between the flanges of the die and can only be removed by manual force.

Application: In addition to bending steam and gas tubes of ⅜ to 4 in N.B. the hand operated or mortised portable hydraulic tube bending machines are able to handle cold and unloaded solid

FINNEY HYDRAULICS

. . . meet the requirements of hydraulic engineers

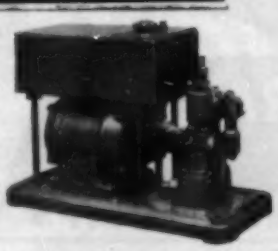


HIGH PRESSURE PUMPS

Oil submerged or enclosed types with Hydraulic pressure control variable from zero to maximum. Pressures up to 7,000 p.s.i. Quantities up to 150 G.P.M.

PRESSURE SWITCH

A new sensitive switch for use with oil, water, and other liquids. Pressure range 400-4,000 psi. Max Micro switch rating 5 amps. at 230 volts AC 3 amps at 28 volts DC. For wide differentials the unit is fitted with two micro switches.



'S' pump of the reciprocating type.

Capacity 65 cubic inches per minute at 5,600 lbs. per square inch. Variable pressure control 1 H.P. MOTOR AT 1,440 R.P.M. Also VALVES TO SUIT ALL REQUIREMENTS.

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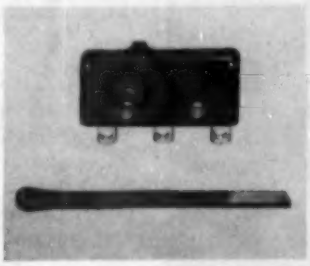
drawn and hydraulic steel tubing up to 3½ in od x 5/16 in wall thickness with the minimum of effort of the operator. Not only can the machines be utilized in the workshop but can be taken and used on site work due to their mobility. They are self contained units and do not require the use of foundation bolts.

Chamberlain Industries, Ltd.,
Staffa Works
Leyton, London, England
Circle 233 on Reader Service Card

SUB-MINIATURE SWITCH . . . built for long life

Designation: Normally open SPST or SPDT
Normally closed SPST
Construction: The case is made of durable plastic material with dimensions of 27/32 in. long, 23/64 in. high and .260 in. thick. The snap action "S" spring compression member equalizes the stress on the switch springs which eliminates early fatigue.
Features: The snap action of the contacts is independent of the speed of actuation. The switch has no dead center and is resistive to shock and vibration. Sturdy terminals that extend from the bottom of the case permit easy soldering without increasing the size of the switch.



Three standard actuators are available, toggle, pushbutton and leaf spring. Hermetically sealed cases have also been developed.
Applications: It's dimensions and long life make it adaptable for use on electronic equipment, guided missiles and similar applications.

Electro-Snap Switch & Mfg. Co.,
Chicago 24, Illinois
Circle 234 on Reader Service Card

For a Money-Back Guarantee
of LONGER SERVICE
specify
PROMET Engineered BRONZE
BEARINGS — BUSHINGS
WEARING PARTS

Sold only under a rigid guarantee of superior and satisfactory service or a refund of the purchase price upon return—the customer's opinion to be final.

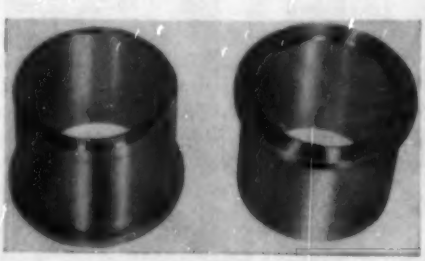
Available in standard and special formulas developed to cope with specific or unusual conditions. Assure the best combination of physical properties, strength in tension and compression, hardness and ability to sustain both static and dynamic loading.

Protect the shaft or other moving parts from injury, scoring, and seizing due to temporary interruption or failure of lubrication, and at the beginning and end of a run when the speed of rotation is insufficient to maintain the oil film.

Will not powder under the most severe conditions of service. Available rough cast or machined to precisely controlled tolerances. They can be machined at surface speeds up to 875 lineal feet per minute.

Castings to your patterns—any size, shape or section—delivered as scheduled and specified. Pattern making, designing and machining when required.

Write today for free literature and service data sheets. Send blueprints, conditions of operation and other data for recommendations and quotations. You are invited to discuss your bearing problems with our metallurgists, engineers, and laboratory technicians.



THE AMERICAN CRUCIBLE PRODUCTS CO.
"Bearing Specialists Since 1919"
1303 Oberlin Avenue • Lorain, Ohio, U.S.A.

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HYDRAULIC CYLINDERS

EVERY MODERN DESIGN FEATURE

- 2000 p.s.i.
- Compact design
- J.I.C. Standards
- 11 models in 11 sizes
- Up-to-date engineering
- All steel construction
- Wide choice of rod sizes
- Quick-change packing cartridge

S-P makes hydraulic cylinders for the world's largest corporations. Representatives in principal cities. Prompt deliveries. Send for copy of S-P Catalog No. 103.

S-P AIR CYLINDERS

Famous for long life—low downtime. Piston packings "replace" themselves. Prompt deliveries. Send for Catalog 102.

OTHER S-P PRODUCTS: Power Chucks, Rotating Air Cylinders, Parallel Grip Collet Chucks, Drill Press Chucks, Expanding Arbors, Blank Jaws, Air Valves, Air Pistons, Air Control Accessories.

SP THE S-P MFG. CORP.
ESTABLISHED 1915
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CLEVELAND 6, OHIO
A Bassett Company

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

Continued from page 52

RUBBER PARTS . . . such as "O" rings for hydraulic and pneumatic design applications made to individual specification, are completely covered in a four page, two color illustrated brochure, released by Goshen Rubber Co. Inc. The company is equipped to produce molded, lathe-cut, die-cut and bonded-to-metal products from natural, synthetic and silicone rubber compounds. It is explained that with the exception of "O" rings, the company's products are not stocked, rather all are produced on order to individual exact requirements.

Circle 157 on Reader Service Card

SOCKET TYPE TUBE FITTINGS . . . for permanently welded joints are announced in catalog No. 4370, released by The Parker Appliance Co. These fittings are available in steel or stainless steel for all commonly needed body shapes. The line includes unions, adapters, connectors, tees, crosses, gage connectors and elbows. Sizes range from ¼ in. to and including 2 in. od.

Circle 158 on Reader Service Card

SILICONE RUBBER STOCK . . . This newly developed product, a fully compounded molded material, is described in a Technical Data Bulletin 9-332 released by Dow Corning Corp. The many advantages are explained in fabricating such items as gaskets, seals, diaphragms, "O" rings, bellows, switch boots and dielectric fittings and connectors from this stock. Parts fabricated remain flexible at temperatures lower than -100 degrees F and may be used in service at temperatures as high as 500 degrees F. It can be used in applications where cosmetics, food or pharmaceuticals may be in contact with the fabricated stock. Typical properties of the product are given. In Technical Data Bulletin 9-333 a silicone rubber paste is described which is used for coating glass cloth or organic fabrics to be used in either mechanical or electrical applications. Typical properties of this product are given.

Circle 159 on Reader Service Card

HOSE CONNECTIONS . . . are presented in a condensed catalog No. 1, released by Hose Accessories Company. The folder consists of the cataloging of hose couplings, hose clamps, valves and manifolds. More in detail, the sizes and features of the following are listed and illustrated; suction or water hose couplings, combination male hose nipples, brass long shank hose couplings, single bolt hose clamps, double bolt hose clamps, universal type hose coupling, universal hose clamps and high pressure hose couplings. Other products such as throttle valves, air valves and manifolds are also cataloged.

Circle 160 on Reader Service Card

ELECTRIC MOTOR LUBRICATION . . . a design feature which directs the transmission of grease transversely from behind the bearing, through the ball race to the opposite side, is described in a very attractive bulletin #1848 released by U.S. Electrical Motors Inc. Comparisons of methods for lubricating electric motors are illustrated together with the principal types of bearings used in motors, cartridge, standard open and lubriflush types, with explanations of the functions of each. For demonstrating the action of re-lubrication in these featured bearings, a series of natural color photos of a transparent bearing housing is reproduced. It is shown photographically that any make bearing breathes air and therefore leads to contamination of the bearing.

Circle 161 on Reader Service Card

HAND PUMP . . . available for 1500 psi and 3000 psi in use for ordnance, aircraft and domestic applications. The body is made of aluminum and the piston and working parts of stainless steel. Pressure can be held at any position of the handle. The catalog sheet is released by Alten Foundry & Machine Works, Inc.

Circle 162 on Reader Service Card

OIL RELIEF VALVE . . . which regulates primary system pressure of oil burner systems is described in a bulletin R-313 released by Eclipse Fuel Engineering Co. Chattering and undesirable pulsation in such systems is eliminated by this piston type relief valve. The cylindrical steel piston closes the port with a quiet, positive shearing action. Dependability in maintaining uniform pressures and the ease and accuracy of the pressure adjustment are a few of the features. The bulletin gives the exterior dimensions, the sizes, and the various pressures obtainable with the use of different springs.

Circle 163 on Reader Service Card

Circle 1 on Reader Service Card

Stops Build Up of Ice, Mud or other Foreign Bodies between Rod and Ring . . .

The wiper edge of the FALL Wiper Ring is TIGHT against the piston rod at all times REGARDLESS OF WEAR. Spring-Loaded, it gives wiper edge a squeeze grip action . . . the squeeze grip is always the same because of the uniform tension of the spring under the endless cover band.

Squeeze Grip Action Does It—*patented*

Ice, grit and other foreign bodies do NOT Build Up under ring. Rod does not stick or become immobile in ANY temperature . . . the FALL ring has complete contact on rod ALL WAYS, always.
Insist on FALL Wiper rings. Available from ¼" to 13" dia. Military part numbers from AN6231A1 to AN6231A71. Write, wire or phone us your wiper needs.

Used During World War 2 and ever since by the Military.
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Ask About FALL Wiper Rings with Closed Joint
Especially designed for those applications where absolute freedom from dirt passing through joint of ring is required.

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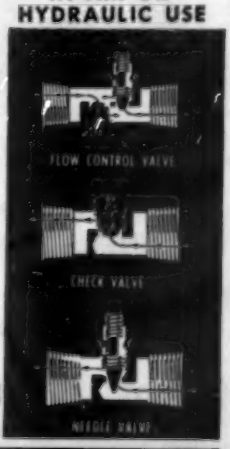
Get Easier, More Accurate Cylinder Speed Control

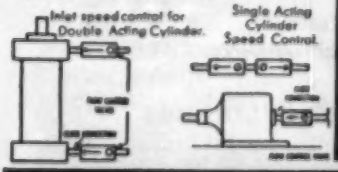
2000 and 5000 (steel) P.S.I.

with **Pneu-Trol VALVES IN AIR OR HYDRAULIC USE**



Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check Valve and Needle Valve incorporate single function features of Flow Control Valve. All valves available in 6 female pipe sizes — ⅛" to ¾". Valve bodies are made from brass, aluminum, steel or stainless steel. Attractive Prices — Immediate Delivery.

Write for Illustrated Circular and Price List.



Pneu-Trol Devices, Inc.
1426 N. Keating Ave., Chicago 51, Ill.

Economical Bronze Design

Series I—Heavy duty bronze rotary gear pumps
Oilless bearings 2-23 G.P.M.—0-100 P.S.I.

Series II—Close coupled motor driven bronze pumps
Oilless bearings 2-4 G.P.M.—0-100 P.S.I.

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Oilless bearings 50-150 G.P.M.—0-150 P.S.I.

Series IV—Rubber impeller bronze pumps
Oilless bearings 6-21 G.P.M.—0-30 P.S.I.

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Grease fittings 2-23 G.P.M.—0-100 P.S.I.

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Grease fittings 2-25 G.P.M.—2-10 P.S.I.

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Industrial Pump Div., Oberdorfer Foundries, Inc.
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Address the 1954 edition of the Oberdorfer Industrial Pump catalog to:

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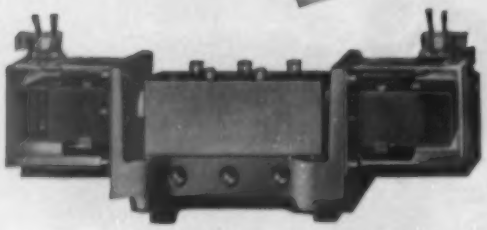
COMPANY .....

ADDRESS .....

Do you want a factory representative to call ☐ Yes ☐ No

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

FEATURE THIS MONTH



⅛" and ¼" Double Solenoid Valves

Their reduced amperage requirement simplifies electrical circuits

● These valves are extremely simple in design — but ruggedly built — and will give millions of cycles of efficient, trouble-free, dependable operation. For air to 125 psi, vacuum, or low pressure hydraulic service. Up to 300 cycles a minute. Solenoid armature bears directly against the valve plunger eliminating levers, links, pins, etc. Low amperage requirement simplifies the electrical circuit. The valve is reversed by energizing first one solenoid, then the other. The valve and both solenoids are mounted on an aluminum base, and can be removed independently without disturbing the piping. 2-way, 3-way, double 2-way, 4-way and 5-way actions.

also the following

DESCALING VALVES

Specially designed for descaling hot strip and large steel forgings. Widely used. 2" to 6" sizes. Capacities to 1550 Gals./Min. Design eliminates destructive water hammer and reduces hydraulic shock to a minimum.

HIGH PRESSURE STRAINERS

Used ahead of descaling valves to prevent foreign material from plugging spray nozzles causing scale streaks in strip—also in hydraulic lines to protect valves, cylinders, and other machinery. 1½" to 6" sizes. Highly efficient. Easily cleaned.

For Fully Descriptive Data Sheets Write

C. B. HUNT & SON, Inc.

Hand, Foot, Lever, Cam, Pilot, Diaphragm and Solenoid Control Valves

1994 EAST PERSHING STREET • SALEM, OHIO

USEFUL LITERATURE

SCRAPER STRAINER . . . is a pipe line strainer with a built-in scraper blade which cleans the screen without interrupting the flow, and without removing the screen. Bulletin 3547, released by Sarco Company, Inc., illustrates how the unit operates and the features and applications of the unit. Inside the cylindrical screen of this pipe line strainer is a scraper blade or brush which rotates like a worm gear. The brush sweeps the inside of the screen, scraping off the solids or scums which drop into a sump. The brush cleans the screen during the actual flow of fluid through the pipe.

Circle 164 on Reader Service Card

REGULATORS . . . for control of air, gas and liquids at high pressure and low volume are covered in a 16 page Bulletin No. 125-C offered by Grove Regulator Company. The units are self-contained and self-operating. They are set manually then operated automatically, maintaining the established pressure. A decrease in system pressure operates the inlet valve, to maintain the set pressure. An increase in vessel pressure causes the relief valve to bleed off excess pressures. The valves are adapted, where reducing, back pressure, relief or combination back pressure and relief is desired. Cut-away views show the construction and operation. Specific data is given for each model shown. Capacity charts for the various models are given complete with instructions on how to use the charts.

Circle 165 on Reader Service Card

AIR AND HYDRAULIC CYLINDERS . . . for operating pressures to 1500 psi are very completely described in a new catalog released by Hydro-Line Manufacturing Company. The catalog contains complete engineering data for their line of hydraulic cylinders, both high and low pressure, and air cylinders. The catalog is designed to assist the engineer in selecting and specifying the size and type of cylinder best suited for the job. It contains basic cylinder information with tabulations of dimensions so that proper cylinders can easily be found. There is also general information pertaining to application, method of piping, and pressure losses through fittings and valves. The book is well illustrated.

Circle 166 on Reader Service Card

HYDRAULIC HOIST CYLINDERS . . . of 25 and 30 ton capacity, for on or off highway application is described in a bulletin W 129 released by Gar Wood Industries, Inc. The hoists feature 70 degree dump angle, an hydraulic cushion of oil in the cylinder head checks piston at end of stroke,

cylinders which open at either end to permit easy inspection and a cross head stop which eliminates possible piston over travel. Hoist specifications are also included.

Circle 167 on Reader Service Card

MEEHANITE CASTINGS . . . Quick, handy reference table for the purpose of casting design and specification are tabulated in a folder released by Meehanite Metal Corp. Physical properties such as tensile strength, compression and modulus of elasticity ranges, fatigue and shear strength, brinell hardness, machinability are some of the many properties shown. The tabular summary in the folder is reproduced from the "Handbook of Meehanite Metals" which is a complete 75 page engineering manual on the metallurgy, properties and applications of Meehanite castings.

Circle 168 on Reader Service Card

SNAP-ACTION SWITCHES . . . designed for use as automatic safeties, limits and interlocks in electrical circuits, are described in Bulletin No. 54 released by Micro Switch, a division of Minneapolis-Honeywell Regulator Company. Supplementary data sheets 64a, 66, 68a, 71, P74 and P75 have been added to complete the bulletin. Exterior dimensions are shown and the principle characteristics for each type are tabu-

Circle 80 on Reader Service Card

Your kind of . . .

Solenoid Valves

There *IS* something better in solenoid valves—the new Marsh Electrimatic. Bodies machined from solid brass stock mean extra strength, greater dependability. Coils are moisture and frost proof. Valves are tight seating, smooth, positive, quiet. Types for wide range of application: direct acting —or pilot operated for large capacity.

. . . **Outline your conditions** and we will tell you how we can help you with your Solenoid problems.

MARSH INSTRUMENT CO.
Sales affiliate of Jas. P. Marsh Corp.
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conform to J. I. C. standards

RUGGED . . .

Where it counts most!

CARTRIDGE . . . metallic rod-wiper, packing, bushing in one unit.

RUGGED BODY . . . all steel end caps and barrel.

PISTON RINGS . . . step-cut joint, long life, minimum leakage.

PRESSURE . . . 2,000 psi heavy-duty . . . 3,000 psi non-shock.

SIMPLICITY . . . no tie-rods . . . no retainer rings.

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QUICK COUPLERS
For All Hydraulic Lines

What's Your Hydraulic Line Problem? There's an answer in the ONLY COMPLETE SELECTION

ULRIX offers a model and size for any problem—standard and break-a-way types. ULRIX QUICK COUPLERS connect under pressure without tools.

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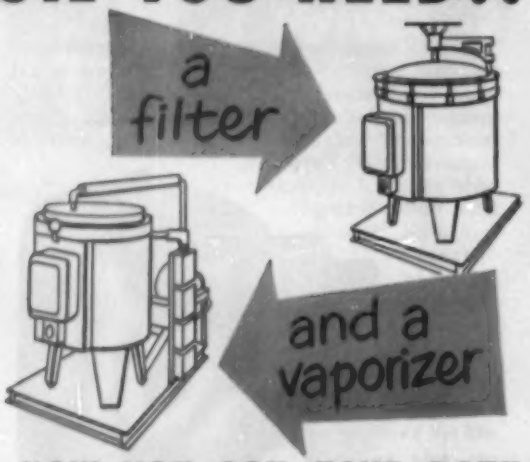
ULRICH MFG. CO. ROANOKE, ILL.

TO RECONDITION DIRTY HYDRAULIC OIL YOU NEED...



NOW YOU CAN HAVE BOTH A FILTER AND A VAPORIZER IN ONE COMPACT UNIT—

The HOFFMAN Oil Conditioner

The Hoffman Oil Conditioner restores contaminated hydraulic oil to a "like new" condition. The unit operates unattended, removing both soluble and insoluble material from dirty oil and recirculating clean oil to the hydraulic system.

The cartridge filter removes all insoluble sludge, acid and metallic particles. The oil vaporizer, operating with low temperature and low vacuum, drives off water and other soluble liquids.

The Hoffman Oil Conditioner assures clean hydraulic oil at all times with little maintenance. The unit operates with no moving parts except motor and pumps. No high speed bearings or parts to increase repair and replacement costs.

Models are available from 25 to 600 g.p.h. Portable Oil Conditioners are available where a more flexible operation is needed.

Write for detailed case studies or for Bulletin A-667

Hoffman
INDUSTRIAL FILTRATION EQUIPMENT & SERVICE
U. S. HOFFMAN MACHINERY CORP., 239 LAMSON STREET, SYRACUSE 6, N. Y.
In Canada: Canadian Hoffman Machinery Co., Ltd., Newmarket, Ont.

USEFUL LITERATURE

lated. Many types are cataloged including low-force switches with lever actuators, roller plunger switches, double throw switches, sub-miniature switch and magnetic blow-out switches. These are only a few of the types illustrated.

Circle 169 on Reader Service Card

FLEXIBLE COUPLINGS . . . their value and many advantages, all of which is compiled in a 136 page catalog by the Poole Foundry and Machine Company. This catalog No. 53 covers every phase of flexible couplings. Complete with adequate description of how the coupling functions and engineering data on each of the types available. Many illustrations show various types of applications. A cross section view is shown with each type coupling giving all dimensions of coupling, shaft diameter, keyways etc.

Circle 170 on Reader Service Card

KELON-T SPIRAL BACK-UP RING . . . is described in an engineering bulletin No. 1010, released by W. S. Shamban & Company. Other products covered are the Traub Seal designed as a replacement for the usual stem type packing, fluoroplastic laboratory ware, standard "O" rings and valve packings. Other bulletins show what Kelon-T (Teflon) is and the applications, the properties of Kelon-T, properties of Kelon-F (Kel-F, Fluorothene), weights of rods and tubes, Kelon-T and Kelon F sheets, Kelon-T strip, Kelon-T and Kelon F tubing and "O" rings for special sealing. These engineering bulletin numbers are 1001, 1002, 1003, 1004, 1005, 1009, 1011 and 1012.

Circle 171 on Reader Service Card

VALVES . . . A new 48 page catalog No. 200 has been released by the Bridgeport Thermostat Division of Robertshaw-Fulton Controls Company. The valves are used for electrical (direct current) or pressure control of a variety of fluids including air, alcohol, fuel, whitefuming nitric acid, liquid oxygen, hydrogen peroxide and hydraulic fluids. The valves have been designed for guided missile and aircraft use but also find use in other industrial applications. The catalog contains 48 pages including illustrations and descriptions of various types, plus installation drawings and flow curves.

Circle 172 on Reader Service Card

MATERIALS HANDLING . . . An article titled "Hydraulic Power and the Industrial Truck" which appeared in the June 1953 issue of "Lubrication" a technical publication devoted to the selection and use of lubricants, should prove of interest. Requests can be filled for those interested in obtaining the complete article. The back-

SERVING MODERN INDUSTRY

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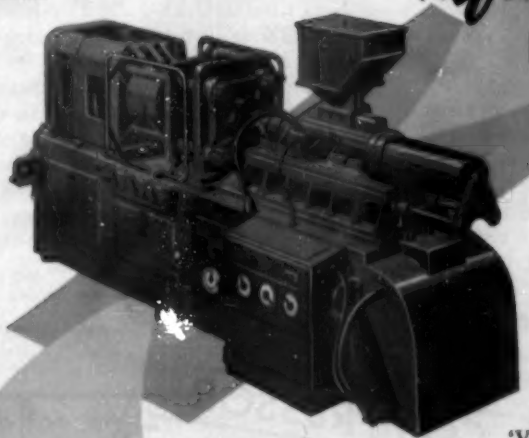
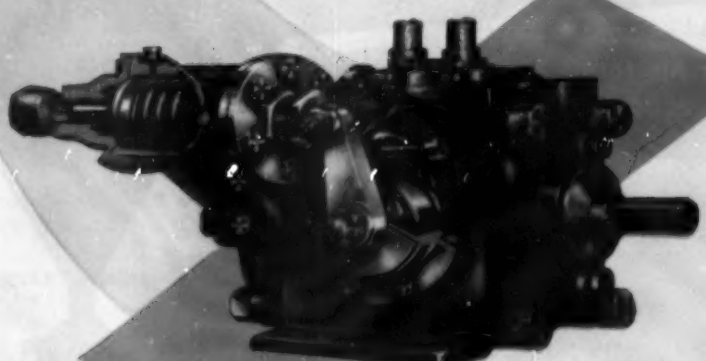
Infinitely VARIABLE DELIVERY PUMPS

The WINDSOR
SH 8/10
Plastic Injection
Molding Machine



'VSG' Auto Pumps are ideal for Injection Molding Machines, the Windsor 10 oz. Machine being a typical example. Standard 'VSG' Pumps and Variable Speed Transmission Gears are available for early delivery. Pump capacities 0-400 gal. per min.: pressure ranges 1,000, 2,000 and 3,000 p.s.i. *Further details will be sent on request.*



'VSG' Variable Delivery Axial Piston Type Pump with Automatic Pressure Control

VICKERS-ARMSTRONGS LTD

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P13c

USEFUL LITERATURE

ground of mechanical materials handling, showing the growth of its usefulness, as industry has become more and more mechanized, reveals that now the success of mechanized material handling depends on two basic elements—namely the unit load and the industrial truck. The development of the industrial truck is discussed and many types of these trucks are described. The application of hydraulic power in industrial trucks shows the many advantages in controlling the load which would otherwise not be available. The purposes of the many types of valves used in material handling applications shows the versatility which can be obtained with such devices. Helpful comments are made in regard to hydraulic oils and suggestions on preventative maintenance.

Circle 173 on Reader Service Card

STUDMOUNT CYLINDERS . . . for use in air and hydraulic systems, with interchangeable heads and mounting brackets are presented in a bulletin #225, released by Magicair Div. Pneumatic Products, Inc. Three styles are available; the studmount with the "in-line" part of the rear head; the head "with a tongue" is used in the rear whenever the cylinder must be fastened down by means of brackets; the double ended cylinder is "standard". The features are shown and some descriptive material is given for each. An air-operated clamp type cylinder with a 1 in stroke is presented in bulletin #101. This miniature cylinder can be foot mounted, rear mounted, and front mounted. Installation dimensions are also included.

Circle 174 on Reader Service Card

PISTON RINGS . . . Cast iron and hardened steel die casting plunger piston rings are tabulated on a data sheet released by The Auto-Diesel Piston Ring Co. Diameters range from 2 in to 4⅝ in and in widths of ¼, ⅜, ½ and 1⅛ in. Wall thickness is also shown for each diameter ring. Price list is available showing prices for both cast iron and hardened steel rings.

Circle 175 on Reader Service Card

TEFLON . . . tetrafluoroethylene resin is discussed in a third revision of E. I. DuPont De Nemours & Co.'s technical bulletin on this subject. The 12 page bulletin lists seventeen new applications in addition to those reported in the earlier edition of the bulletin. Various finishing systems of "Teflon" primers and enamels over metallic and non-metallic surfaces are discussed together with application methods, fusing operation and handling procedures.

Circle 176 on Reader Service Card

BETWEEN YOUR COMPRESSOR
AND YOUR END USE
Get Air that's Specially
AFTERCOOLED, SEPARATED, FILTERED
The R. P. Adams Co., Inc. specializes in the engineering and manufacture of the vital air conditioning equipment that goes between your compressor and your air tools.
As most plant engineers know, aftercoolers are selected on their own merits to produce, in combination with Cyclone Separators and Poro-Stone filters, the right amount of clean, dry air.
Specify Adams aftercoolers, whether your compressor is new or old.
Write for Bulletin 177 for performance facts.

R. P. ADAMS CO., INC.

249 E. PARK DRIVE
BUFFALO 17, N. Y.

AIR VALVE . . . recently introduced as wobble-rod air valve by Pantex Manufacturing Corp. is described in an 8 page bulletin No. 61861. The air valve, it is explained, offers to designers and users of machinery and processing equipment an on-off control with pneumatic systems. In addition to giving specifications, the bulletin evaluates the unique features of the valve and illustrates application ideas covering a variety of actuating mechanisms hook-ups and multiple valve arrangements. Included are photographs, both of the valve and its use in cam actuated mechanisms, sectional drawings to permit study of the valve's internal check valve, exhaust valve and other features. Installation diagrams, with all necessary dimensions are also included.

Circle 177 on Reader Service Card

AIR AND HYDRAULIC CYLINDERS . . . are described in a folder offered by Petch Manufacturing Co. The various types illustrated are, the tie-rod design, internal keeper ring type, automotive heavy duty air, and boosters and tanks. All pressures and bores are given for each type. A cross section view of the tie-rod design shows the construction of the unit.

Circle 178 on Reader Service Card

ROTARY PUMPS . . . of various capacities are presented in an 8 page Catalog 954 prepared by Geo. D. Roper Corp. How the pumps operate.

Available for the first time!

FLUID POWER CIRCUITS

It's the first time that more than 80 air and hydraulic circuits drawn to JIC Standards have been published under one cover. This 32 page booklet will help you with design and maintenance problems of your fluid powered equipment. Here are some of the subjects covered:

Pump Unloading Methods
Pressure Regulating Circuits
Speed Control Circuits
Accumulator Applications
Sequencing Methods
Motion Synchronizing Circuits
Electrically Controlled Circuits
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APPLIED HYDRAULICS Magazine
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Please send me ..... copy (ies) of "FLUID POWER CIRCUITS" at the price of 50 cents per copy. Check is enclosed.

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STRAIGHT LINE FLOW NO PULSATION
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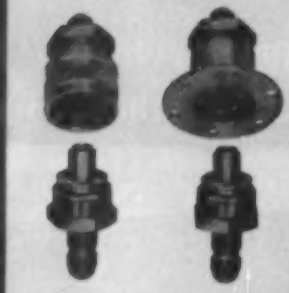
WIGGINS INST-O-MATIC COUPLINGS

QUICK—DISCONNECT

3000 psi



Manual Quick Disconnect (Push-Pull Positive Action)

Automatic Quick Disconnect (Breaks Away at Pre-determined Weight Load)

for high pressure HYDRAULIC FUEL and PNEUMATIC Systems

SIZES: 1/4" TO 2 1/2"

WRITE FOR FURTHER INFORMATION

Wiggins

E. B. WIGGINS OIL TOOL COMPANY, INC.

3424 East Olympic Boulevard, Los Angeles 23, California

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complete with colored illustrations, data tables and construction features are given very completely. One series of pumps, rated at 60 psi is designed to handle thick or thin liquids at slow speeds. Another series is adaptable to pressure lubrication, hydraulic service, fuel supply or transfer work pumping clean liquids. Available are pressures of 25, 50, 100 and 150 psi. Still another series is used for all types of hydraulic mechanisms, steel mill equipment and wherever high pressures are required. These pumps are for pressures up to 1000 psi.

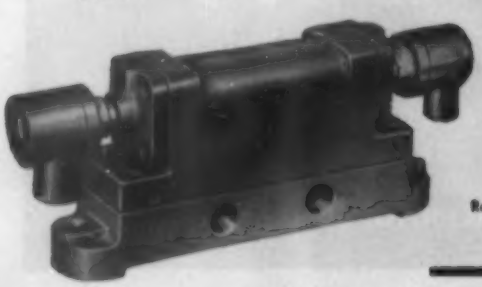
Circle 179 on Reader Service Card

AUTOMATION . . . of machine tools is presented in a 24 page brochure in color by Turchan Follower Machine Company. The three main divisions of the company are covered which are, hydraulic duplicating attachments for standard machine tools, designing and building complete control systems for machines and complete new tracer-controlled machine tools made by the company. Each of these subjects are covered very completely with illustrations and applications. This question is raised, "Why buy new machine tools to increase shop capacity when a servo-control system can be applied to your present machines to increase machine capacity at lower cost".

Circle 180 on Reader Service Card

NOPAK Model "V" Type AR, 4-Way Pilot Operated Slide Valve. Unbalanced piston shifted by energizing a normally closed 3-way solenoid pilot.

NOPAK Model "V" Type R, 4-Way Pilot Operated Slide Valve. Balanced piston is shifted by means of normally closed cam, hand, foot or two-way solenoid bleeder pilots.



Widely Adaptable

NOPAK Model "V" 3-and 4-Way PILOT OPERATED SLIDE VALVES

Pilot Pressure or Bleeder Operated . . . these unique valves permit an infinite variety of cycling in the direct or remote control of continuous or intermittent cylinder action. They may be energized by means of 2-way hand, cam or foot poppet valves or with solenoid pilot or bleeder valves. Light weight, all-aluminum construction, simple design and small size make them extremely versatile, and adaptable to many uses which other valves cannot fulfill. Operate at air pressures from 20 to 150 psi.

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Write for NOPAK Bulletin V

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Representatives in Principal Cities

NOPAK

VALVES AND CYLINDERS

DESIGNED for AIR and HYDRAULIC SERVICE

WATER FILTERS . . . have been added to the regular Marvel Engineering Company filter line without changing the basic design. The sump and line type units have been adapted for water application. Catalog 300 gives complete information on the filter. These filters will remove foreign matter and thus prevent damage to pumps and they eliminate scoring of cylinders and valves. Grit and other impurities in the water may result in the scoring of sliding or rotating surfaces, as well as impairing the smooth functioning of pumps, valves, cylinders, regulators, gages, ports and orifices. All pertinent data is given with regard to types, sizes, gpm, screen mesh, filtering area etc.

Circle 181 on Reader Service Card

ROTARY PUMPS . . . using the gear-within-a-gear principle are presented in an 8 page booklet released by Viking Pump Company. With every revolution of the pump shaft a definite amount of liquid is drawn into the pump, filling the spaces between the teeth in the idler and rotor as they pass the inlet port. The liquid is forced out of the spaces into the outlet or discharge port by the meshing of the teeth at a point midway between the two ports. Data charts showing pertinent information, applications and features are included. Many types are illustrated including those for special applications.

Circle 182 on Reader Service Card

For precision-made seals use LINEAR "O" RINGS

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"We use Briggs clarifiers to purify the oil for operating all our hydraulic speed selectors. Briggs is standard on all of our ram and saddle type turret lathes. With Briggs the improved performance has more than offset the cost."

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Without cost or obligation send me:
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Post Scripts of Industry

News about people, manufacturers and sales organizations

Leonard M. Dorman
Fluid Controls, Inc.

Kenneth E. Jenkins
The Parker Appliance Company

Kenneth J. Downs
Chiksan Company

Fluid Controls, Inc., of Mentor, Ohio, announces that **Leonard M. Dorman** has joined their organization as assistant general manager. Dorman recently resigned his position as manager of the Plastics Division of Talon, Inc. to accept the new post. While at Talon he invented the high speed shuttleless loom and developed several types of plastic fasteners and the methods for producing them.

Appointment of **Kenneth E. Jenkins** to the newly created position of industrial hydraulics division sales manager for **The Parker Appliance Company** of Cleveland is announced by D. W. Holmes, vice president in charge of sales. The company is expanding its efforts in the field of fluid and hydraulic system components for applications on machine tools and mobile equipment. The industrial hydraulics division sales will be coordinated and supervised by Jenkins from the firm's home office in Cleveland, Ohio. Jenkins has more than sixteen years experience in the hydraulics industry. He formerly occupied an executive position in the industrial sales division of Vickers in Detroit.

Kenneth J. Downs, has been appointed chief design engineer of **Chiksan Company,** it has been announced by Gus N. Bagnard, chief engineer. In his new capacity, Downs will supervise the design and development section of the engineering department and will direct the operation of the test laboratory. He has been with the company four years as a design engineer. For the past several years, Downs has been engaged in engineering work both here and abroad, particularly in the automotive industry.

Robert C. Kerr has been appointed branch manager of the Detroit office of **Graton & Knight Company,** replacing Willard A. Stearns who passed away in December. Kerr was formerly a sales engineer in the Detroit office. Before joining the company in 1952, he was the New Jersey district manager for Air Products, Inc. **William L. Harris** has been appointed sales engineer at the company's Detroit office. He was formerly engaged in production and laboratory work on synthetic rubbers at the affiliate company, International Packings Corp.

The Darling Valve & Manufacturing Co., Williamsport, Pa., has announced the appointment of **Bertil E. Engstrom** as midwest regional sales manager. Engstrom joins the company after several years with Minneapolis-Honeywell where he served as assistant sales manager, and more recently as regional sales manager. He will head the sales in roughly a dozen states extending from the east Ohio border to the west border of the Dakotas, to the south border of Kentucky.

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Post Scripts of Industry

A new pilot plant for the production of a unique line of synthetic hose developed for the aircraft industry has been placed in service by **Resistoflex Corporation** at Belleville, New Jersey, Edgar S. Peierls, president has announced. The new product, made basically of a plastic derived from fluorocarbon resins, is expected to handle the synthetic fuels and oils specially developed for the latest design jet engines. These new fuels and oils are subjected to temperatures heretofore unknown in aircraft operation. Consequently, materials for handling them must not only be able to withstand these extremes of temperature but must also be chemically inert to resist corrosion. Initial reaction by major aircraft producers to original test material developed by Resistoflex engineers was so great that a pilot plant was planned immediately to meet the urgent need for additional test material and initial small production quantities.

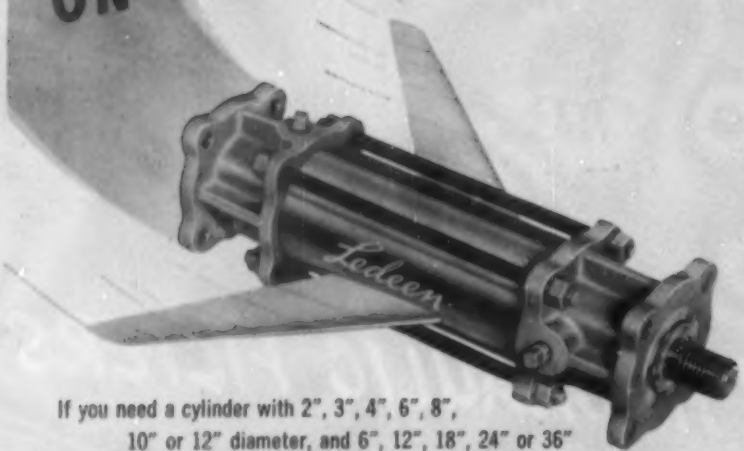
Ben W. Badenoch
Vickers, Inc.

Ben W. Badenoch has been advanced to the position of aircraft products sales manager at **Vickers, Inc.** He will be based at the Detroit general offices. Badenoch has been associated with Vickers for five years in charge of the west coast aircraft sales activities at the El Segundo office. During the past year he also assumed responsibility for the activities of a new special products engineering group, at the company. Badenoch replaced **T. B. Doe, Jr.** who has been advanced to the manufacturing division where he will be responsible for process engineering, tool control and allied activities for all company products at the Detroit, Omaha and Joplin plants.

Edward N. Cunningham
Precision Rubber Products Corp.

Precision Rubber Products Corp., Dayton, Ohio has announced the promotion of **Edward N. Cunningham** from the post of assistant sales manager

Ledeen PUTS WINGS ON THEIR CYLINDERS!



If you need a cylinder with 2", 3", 4", 6", 8", 10" or 12" diameter, and 6", 12", 18", 24" or 36" stroke, check with us. We usually have it in stock and if we ship it air freight tonight, you will have it tomorrow or the next day. If you need a cylinder with a different stroke length, we have the necessary components to assemble and ship your cylinder in a matter of just a few days.

• and when you get it, you will have a cylinder that is sturdy, reliable and built to give you long and satisfactory service.

Bulletin 500

Ledeen Cylinders are good cylinders.

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VALVE ACTUATORS
AIR-HYDRAULIC
PUMPS & BOOSTERS

Ledeen Mfg. Co.
1610 So. San Pedro St.
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to that of sales manager. Cunningham joined the technical sales staff of the company in 1951. Prior to that, he was with the B. F. Goodrich Company, Akron, Ohio. His experience has included both sales and technical service work, much of which has been with the specialty synthetic rubbers. He has served on a number of technical committees, whose chief function was to develop rubber specifications for the automotive and aircraft industries.

The appointment of **H. E. Elliott** as sales manager, **The Watson-Stillman Company**, Division of H. K. Porter Company, Inc., Roselle, New Jersey, was announced by **A. B. Diss**, vice president general manager. Elliott has been associated with Watson-Stillman for the past twenty-five years, and was instrumental in developing many lines of hydraulic presses and equipment. **R. W. Schreck** has been appointed assistant sales manager specializing in plastics machinery sales.

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SEND your specifications for hydraulic cylinders to American, specialists in hollow boring and honing. We manufacture from tubing or forgings in carbon or alloy steels up to 15" I.D. Over 40 years experience backed by precision machines and skilled craftsmen will save you time and money. Send your blueprints.

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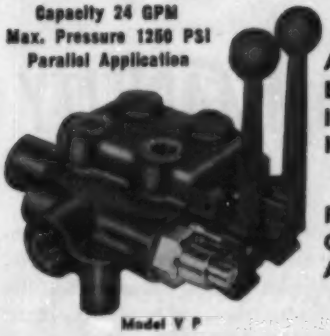
MULTI-CONTROL VALVE

Capacity 24 GPM
Max. Pressure 1250 PSI
Parallel Application



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For Mobile and General Industrial Applications.

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- Tripod Mounting Foot
- Check Valve Effective On All Spools
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- Hardened and Chrome Plated Spools
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Center sections are available making additional Controls in this Multi-unit.

Write for full details about this better built, money saving valve.

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The wrong check valve means trouble ahead!

A check valve that doesn't do its job costs somebody lost time or money—in operation, in maintenance or in product performance. There's no excuse for faulty valve performance in any installation when you can specify Circle Seal. The Circle Seal principle provides a check valve that is guaranteed not to leak. The patented floating "O" Ring construction also eliminates pounding or chatter and provides unheard-of maintenance-free service life.

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Check, Relief, Vent, and Excess Flow Valves
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Heating, Cooling, Air Conditioning Products for Home and Industry.

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Post Scripts of Industry

Carl E. Schmitz
Director of the National Conference on Industrial Hydraulics

Carl E. Schmitz, vice president and general sales manager of the Crane Packing Company of Chicago, has been appointed director of the **National Conference on Industrial Hydraulics** for 1954. The conference is sponsored by the Illinois Institute of Technology and the Armour Research Foundation and a group of Technical Societies. Under the guidance of Mr. Schmitz, the National Conference is fostering a model educational program designed to improve the use, application and maintenance of hydraulic equipment. In cooperation with this program, a research laboratory has been set up at the Illinois Institute of Technology. The National Conference on Industrial Hydraulics will hold its Annual Congress next fall at the Sheraton Hotel in Chicago, Illinois, October 14-15. Outstanding papers will be read by some of the most distinguished engineers in the field of hydraulics.

NFPA Meets in April

THE National Fluid Power Association will hold their First Annual meeting at the Edgewater Gulf Hotel, Edgewater Park, Mississippi on April 6 and 7. The first full meeting of this Association, formed only last May, will receive reports of functional committees, work out

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UCON hydrolubes are hydraulic fluids that contain water for non-flammability. They are balanced formulations of water, an anti-freeze, and a water-soluble synthetic lubricant. They contain carefully selected corrosion inhibitors, metal deactivators, and anti-wear agents. As long as the water concentration is maintained, UCON hydrolubes are non-flammable.

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and set up definite goals for the activities already established and elect officers for the next year.

Committees appointed at the first Fall Meeting last October have, in nearly all cases, held either full or sub-committee meetings. A considerable volume of planning and preliminary work has been done. No time has been allowed for Committee meetings during the two days of the meeting.

However, there will be a meeting of the Executive Committee on Monday, April 5. While a recreational program is available to members and prospective members who come a day early, chairmen of various committees may use the preceding weekend as well as Monday for completing committee projects.

Barrett Rogers, Executive Secretary, NFPA, reports that the membership has passed 60 manufacturers in the hydraulic and pneumatic fields. John C. Hanna, Vice President, Hanna Engineering Works, is General Chairman of the Association.

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Auto-Diesel Bronze Scraper Rings prolong the useful life of components used in pistons and therefore expensive down-time is reduced to a minimum. They are precision made by men who have specialized in rings since 1921. Auto-Diesel Scraper Rings are LONG-WEARING because they are made right. They have been tested at 2,250,000 cycles and found to fit perfectly. Can supply in sizes from ⅛" to 13" I.D. We also make rings and circular parts for jet engines. Auto-Diesel Engineers with years of experience back of them are qualified to assist in solving your ring problem. You are requested to write.

Get Longer Life of Components used in Pistons By using AUTO-DIESEL SCRAPER RINGS AN 6231 . 1 to 71

Do you need piston rings in small quantities? Auto-Diesel is especially set up for this type of business and can produce "short runs" economically and sell them at attractive prices. Since 1921 we have supplied hundreds of customers—many of them exclusively. We also make circular parts to your specifications. Auto-Diesel Piston Rings are made up to 35" diameter for original equipment and for replacement in compressors, hydraulic cylinders, valves, etc. Write for prices.

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PRESSURE PLUGS

seal tight
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When UNBRAKO Pressure Plugs are tightened, major and minor diameters are positively sealed, pressure tight without sealing compound. UNBRAKO Dryseal-Thread Pressure Plugs, in a full range of sizes from ⅛" to 1¼" NPTF, are available from your local UNBRAKO distributor's stocks. Write for literature. STANDARD PRESSED STEEL Co., Jenkintown 2, Pa.

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Double acting Trunnion Mounting BHEW hydraulic cylinder.

BHEW HYDRAULIC CYLINDERS

It's easy and practical to use BHEW hydraulic cylinders in your applications. Accurately honed barrels, hard chrome-plated rods, small O. D. and any type mounting desired are BHEW cylinder features. All types and sizes available in standard and special O. E. M. designs. BHEW makes single and double acting, high and low pressure cylinders with cup-type, ring-type or O-ring construction. Send specifications of your requirements.

BHEW Pressure Operated Hydraulic Flow Control Valves, for lift trucks, eliminate surge as load starts down. Load weight controls rate of descent, full speed raising and empty fork travel. Write for details.

Benton Harbor Engineering Works, Inc.
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Post Scripts of Industry

Martin J. Laughlin
Gibson Engineering Company

Martin J. Laughlin joins **Gibson Engineering Company** as field engineer. He attended Notre Dame University and Northeastern University. Formerly in design liason section of Boston Naval Shipyard, he will handle sales engineering in New England territory.

Formation of **International Testing Service**, a division of Jackson and Church Co., Saginaw, Michigan, to provide engineering services to firms facing problems in testing, instrumentation and related fields of research and development, has been announced by president, Clifford W. Stuart. Staffed with experienced scientists and engineers performing all types of testing utilized by industry, the organization is designed to provide a number of services, including complete field crews to meet specialized problems including transient, dynamic and static testing. Director of ITS is **Dr. Perry M. Banta**, formerly manager of engineering test laboratory for Lockheed Aircraft Corp.

The appointment of **M. G. Lucke** as superintendent of moulded hose, **Quaker Rubber Corp., Division** of **H. K. Porter Company, Inc.**, Philadelphia, was announced by C. A. Dauphinais, vice president and general manager. Lucke will be in charge of all moulded hose production for the company. His experience includes positions as hose development engineer and superintendent of hose production for rubber goods manufacturers.

Arthur E. Jones and **Wayne Belden** were honored at the annual company dinner of the **Ajax Flexible Coupling Co. Inc.** for over 25 years association with the company. Mr. Jones, president of Arthur E. Jones Co., Inc. has represented Ajax throughout the central and western New York State territory throughout that period. Wayne Belden is executive vice president of Ajax.

The Paquin Company in Cleveland, Ohio, has announced the opening of a new warehouse at 630 Brandt Street, Dayton, Ohio. This will provide faster service for their stocks of hydraulic parts. The same items will be carried in Dayton as in Cleveland. The warehouse is

for original equipment vacuum pumps

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Motor-Pump Model 0406—To .6 CFM, 25" vac. Wt. 16 lbs., 10¼" long.

V-belt Model 1550-V2—To 10 CFM, 15" vac. For paper feeding, etc.

Heavy-duty, fan-cooled Model 1065-V4-34. To 28" vac. with ½ HP.

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Blower accessories standard.

YOU GET HIGH QUALITY that solves product problems with long-lived high performance . . . a result of dependable rotary-vane design plus rigid quality control.

A WIDE CHOICE OF SIZES from five basic types to 24 CFM or 28" vacuum. Some models oil-less construction. Our volume sales cut your costs!

YOU GET FULL COOPERATION from Gast engineers backed by over 25 years' experience building vacuum pumps for original equipment. For willing cooperation, call on Gast!

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Write GAST—describing your specific application. Request Catalog and "Ideas" Booklet.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY AIR MOTORS • COMPRESSORS • VACUUM PUMPS

(TO THREE H.P.) (TO 30 CFM) (TO 26 INCHES)

GAST MANUFACTURING CORP., 181 Hubbard St., Benton Harbor, Mich.

The Biggest PLUS VALUE in Cylinders

For hydraulic pressures up to 1500 or 3000 p.s.i.

They're sturdy—dependable—economical

Use the hydraulic cylinder that will always give you plus performance in your equipment. Designed and constructed to J.I.C. standards, NEPTUNE-POWER PLUS cylinders are available in seven standard mountings—series 1500 for oil and water pressures to 1500 p.s.i.—series 3-1500 for pressures to 3000 p.s.i.

- Bores from 1 to 24 inches —Strokes to 18 feet.
- Pressure ring design permits head rotation to any pipe location.
- Precision fitted piston rings prevent by-pass while offering minimum friction.
- One piece high pressure, self-adjusting, rod packing provides precision bearing and guide for piston rod.
- Single or double end rods, with cushion.
- Other series available for air pressure.

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equipped with complete facilities, such as office, shipping room, hydraulic test stand and repair shop. All devices which are sold by the company, can also be serviced by the company. The major items stocked are, steel tube fittings, hydraulic hose assemblies, directional valves, control valves, pressure switches, gauges, filters and accumulators.

ASME Hydraulics Meeting

A meeting of the ASME fluid power sub-committee, of the machine design division, was held on Tuesday, February 2, 1954, at the ASME Building. A. J. DeMattio of the Watson Stillman Company, presided. The speaker of the evening was C. G. Ellis, who is the eastern district manager of The Oilgear Company. The subject of his talk was "Hydraulics in Automatic Control" in which comparisons were drawn betwen valve controlled hydraulic systems and variable delivery pump-controlled systems. The relative merits of each were discussed. The paper was prepared jointly by R. E. Davis and C. G. Ellis. Mr. Davis is also with The Oilgear Company. A movie was shown, featuring carriage and canning machinery drives.

Robert Von Rotz
Tuthill Pump Company

The appointment of **Robert Von Rotz** as chief engineer of **Tuthill Pump Company**, Chicago, has just been announced by H. T. Kessler, president. Von Rotz has an extensive engineering background covering many years of technical and manage-

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THE REID WAY

Teflon
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RINGS

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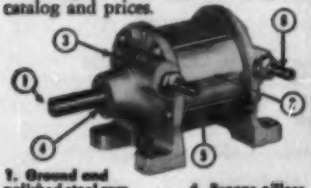
4 Mounting Types



1. Ground and polished steel ram
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LARGE PROCESSOR CHOOSES
Nicholson Valves for LONG WEAR

Nicholson cylinder control valves recently completed 10 years of constant use, without servicing, on an operation which had "proved too much for other tested units." This report, from a large rubber firm, again confirms the fact that Nicholson valves, with their specially treated hard seats and non-corrosive lapping flat discs, become tighter with use. Nicholson furnishes valves for cylinder control, distributing and metering service, and for many special operating cycles. For air, gas, oil, steam, water.

Foot models (right), ¼" to 1½"; press. to 300 lbs.

Solenoid (left) and motor types, ⅛" to 2½"; press. to 375 lbs. Lever models (right), ¼" to 2½"; press. to 5000 lbs.

CATALOG 552
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W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

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ment experiences, with leading corporations. He brings with him wide training in research, development and design in both the low and high pressure pump fields. Prior to his joining, Tuthill, Von Rotz served as chief engineer with Applied Research and Development Corp.

Eastern Company Takes New Name

A change in name is announced by The Airoyal Co., successors to Compressed Air Products. Since 1936, Compressed Air Products has been serving New York, New Jersey and New England as manufacturers' representatives specializing in the sale of hydraulic and pneumatic components. The name AIROYAL is a combination of the words "air" and "oil", and was chosen as being more descriptive of the company's operation than the original name.

In addition to the change in name, which became effective February 1, 1954, The Airoyal Co. announces an enlargement of its management structure. Henry B. Drake, Jr. of the New Jersey office and Martin H. Lipton of the New York office, have joined with Addison T. Smith and Walter A. Ellis. Both Drake and Lipton have had many years experience in the sale and application of fluid power components and systems. The increase in the size of the management will permit the company to continue its policy of close customer-management relationship. The Airoyal Co. offices are located at 1977 Springfield Ave., Maplewood, New Jersey and 6 Church Street, New York City.

Addison T. Smith

Walter R. Ellis

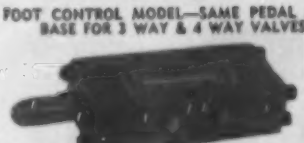
Henry F. Drake, Jr.

Martin H. Lipton

MODERN air fluid POWER

BV SERIES VALVES
¼ INCH PORTS 3 WAY & 4 WAY

• FOOT CONTROL MODEL—SAME PEDAL AND BASE FOR 3 WAY & 4 WAY VALVES



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CYLINDERS
CONTROL VALVES
PILOT VALVES

All components required for complete automatic and sequence circuits:

Engineering of control circuits

Modernair CORPORATION

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Promotion of **S. N. Bean,** chief tool engineer of **Lockheed Aircraft Corporation's** California division, to the position of chief manufacturing engineer for the company's Georgia division has been announced. Bean, who has been with the company since 1940 will assume his new duties in early February according to Burt C. Monesmith, California division vice president. He will fill a vacancy at the Marietta plant caused by the advancement of **R. R. Kearton** to assistant manufacturing manager. In a series of other executive changes, **J. A. Thomson,** sales administration manager was appointed director of parts and services at California. He replaces **C. F. Nielson,** recently named director of military relations. **W. A. Pulver,** who has been works manager at Factory C will become chief tool engineer. **H. D. duChemin,** fighter assembly division superintendent, becomes Factory C works manager.

Appointment of **C. B. Allen, Jr.,** as Detroit district manager of the **Reliance Electric and Engineering Company,** has been announced by E. E. Helm, sales vice president. Allen succeeds J. L. Buell, Jr., who has resigned.

Helm also announced the addition of six application engineers to branch sales offices. They are: **A. W. Bridges** and **L. W. Kutz,** Philadelphia; **C. A. Emmert,** Baltimore; **James W. Landers,** Newark; **William M. Morris, Jr.,** New Haven; and **William J. Constandse,** Cincinnati.

Robert G. Dobbin has been named manager, Commercial Engineering Section of **Jack & Heintz, Inc.,** Cleveland, Ohio. It has been announced by Joseph Mulheim, the company's chief engineer. Dobbin replaces E. P. Codling. Dobbin, who joined the company early this year as design engineer, will direct the engineering activities on fractional horsepower motors. For more than ten years he served as a designer of this type of motor with General Electric Company. Prior to joining the

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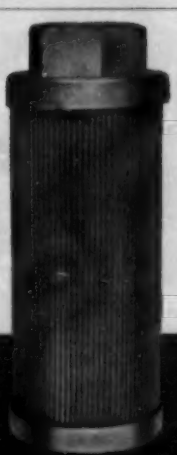

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company he was acting as motor consultant for International General Electric. **J. Parks Hutcheson, Jr.**, has joined the company as an application engineer of the commercial motor section, according to Edmund C. Sulzman, vice president of sales. Hutcheson has been assigned the Ohio-Pennsylvania territory, operating out of Cleveland. He replaces **Anthony Schmidt** who recently became the firm's first full-time commercial motor application engineer on the west coast, with offices in Los Angeles. Prior to joining Jack & Heintz, Hutcheson was serving as manufacturer's representative for the Master Electric Company, in Dayton.

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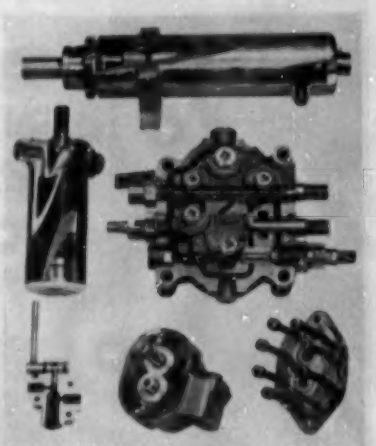

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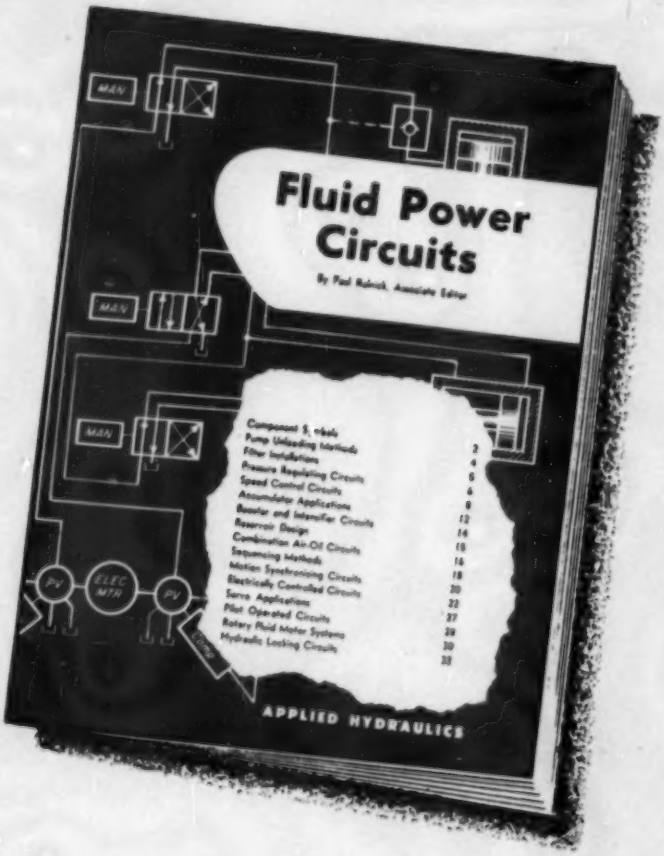

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